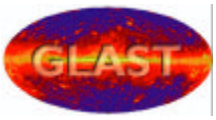
Procédure		
	**GLAST LAT CAL** **Mechanical Structure**	Ref : GLAST-LLR-PR-070 Issue : Draft Date : October 2, 2003 Page : 2

Procedure of manufacture of Composite structure of the Calorimeter Structure of flight

"As Run" Procédure	
Date Démarrage:	Date Fin :

Change History log

Ind.	Date	Modifications	Prepared	Checked	PA Approval	Project Approval
Draft	02 Octobre 2003	**Création**	O. Ferreira	S. Le Quellec	S. Le Quellec	O. Ferreira

AS-RUN SUMMARY

IDENTIFICATION		
Equipement:	**Modèle:**	**Numéro de Série :**

OPERATEURS

The operators mentioned below certify the correct execution of this Procedure As-Run in agreement with its contents

Nom	Fonction	Date	Signature

OPEN TASKS

Test	Phase	Etape	Commentaires	Clôture	Date

NON CONFORMITES

Test	Phase	Etape	Spécification	Résultat	FA n°	FA Titre

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Liste des Acronymes

AD / RD	Applicable / Reference Documents
ADP	Acceptance Data Package
CAL	sous-système calorimètre du LAT
CIDL	Configuration Items Data List
EIx	Empilement Inférieur n°x
ELx	Empilement Latéral n°x
ESx	Empilement Supérieur n°x
FA	Fiche d'Anomalie
FM	Flight Model
GLAST	Gamma-Ray Large Area Space Telescope
LAT	Large Area Telescope
LLR	Laboratoire Leprince-Ringuet
N/A	Not Applicable
NRL	Naval Research Laboratory
PCI	Plaque composite inférieure
PSI	Plaque composite supérieure
SLAC	Stanford Linear Accelerator Center
TBR	To Be Resolved
TBD	To Be Defined
TBC	To Be Confirmed

1. OBJECT

This procedure describes the manufacture of the composite-made part of the mechanical structure of the modules of flight of the calorimeter of GLAST.

This unit is made up:

- of a structure in epoxy resin and composite carbon fibres
- titanium alloy inserts
- of an aluminium foil of shielding having had a surface treatment Alochrome 1200.

2. DOCUMENTATION

2.1 APPLICABLE DOCUMENTS

The documents below are necessary for the realization of the activities:
(the last exit is applicable except contrary specification)

	Titre	*Référence*	*Iss*
AP01	Plan de définition de la pièce	GLT-LLR-00-02	B
AP02	Plan de fabrication des inserts supérieurs	GLT-LLR-00-04	D
AP03	Plan de fabrication des inserts inférieurs	GLT-LLR-00-05	B
AP04	Plan de fabrication des inserts latéraux	GLT-LLR-00-03	B

2.2 REFERENCE DOCUMENTS

	Titre	*Référence*
RD01	Spécifications d'approvisionnement du pré imprégné	GLAST-LLR-PR-048
RD01	Procédure d'utilisation du pré imprégné	GLAST-LLR-PR-068
RD02	Procédure de découpe et empilage du pré imprégné	GLAST-LLR-PR-035
RD03	Procédure de contrôle d'entrée	GLAST-LLR-PR-071
RD04	Elément constitutif du moule	GLAST-LLR-LI-075

3. ENVIRONMENT

3.1 BUILDINGS

3.1.1 Preparation of the mould

The preparation of the mould includes/understands the stages of cleaning of the various parts and the application of the release agent. They are carried out in the machine shop of the LLR, on a marble dedicated, beforehand cleaned to acetone and ethanol.
Dust and particles of fibres or resin generated by the operation of cleaning do not authorize the realization of this operation in clean room. The use of unmoulding in confined environment is not authorized, for safety measures.
The parts, once cleaned and treated, will have to be protected from any source of contamination by an adequate packing before being transferred in clean room for the following operations.

3.1.2 Draping

The draping of impregnated pre fabric is carried out in the clean room of the LLR. The room is of class 100000, at temperature controlled with 20°C ±2°C and degree of hygroscopy maintained lower than 60%.
These conditions will be controlled regularly by the Qualité person in charge during the phases for manufacture.

3.1.3 Polymerization of the structure

The polymerization of the structure after draping is made in the autoclave located in the workshop of mechanics of the LLR. The pre impregnated one is protected perfectly from any source of contamination by the tools of moulding.

3.1.4 Release from the mould of the structure

The release from the mould of the structure is carried out in the workshop of the LLR. Same remarks that for the preparation of the mould apply.

3.1.5 Metrological control

The dimensional check of the structures is carried out in the room of metrology of the LLR. The room is air-conditioned with 20°C ±3°C and in light overpressure so as to minimize the degree of dust contamination.

3.2 PERSONNEL

The whole of the tasks will be carried out by qualified personnel. The team will be at least made up of:

- 1 person in charge for the activity
- 1 qualified technician
- 1 representative quality

3.3 MATERIEL CONSUMABLE

The consumable material hereafter is necessary to carry out the activities.
The operators will make sure that these products are equipped with a certificate of validity in order so necessary.

3.3.1 Equipment of the personnel

At the time of the operations in clean room, the personnel will have to conform to the rules and procedures of use of the clean room of the LLR (GLAST-LLR-Pr-032). The following articles are placed at the disposal:

- Protective gloves out of latex not powdered
- On fit
- Blouses
- Charlottes

3.3.2 Cleaning

At the time of the operation of draping, the cleaning of the parts, surfaces and tools will be done using products adapted to a use in clean room:

- Isopropanol high purity
- Fabrics

Industrial products will be used in the environment machine shop of the LLR.

- Ethanol
- Acetone

3.3.3 Unmoulding

- H3R Alex 22

3.3.4 Others

- Paper imperatively under plastic small pocket
- Ball point pen
- Indelible felts

4. TOOLS AND EQUIPMENT

The manufactures of has structure will Be whitebait to start only yew all the material and equipment listed below and in the document GLAST-LLR-li-075 are available and in state. The pre cuttings impregnated one will Be whitebait to cuts left the freezer only after checking of the material and the equipment.

4.1 HAND TOOLING

- Screwdriver
- Keys
- Roller
- Slide caliper
- Bars composite of the EM

4.2 TOOLS OF CUTTING AND DRAPING

The phase of draping of pre impregnated includes operations of cutting. The following equipment will cuts to Be available in clean room:

- Carpet urethan of cutting
- Cutters and blades of replacement

The winding of the cores of the mould will cuts to Be carried out one year adapted surface:

- Expanded foam carpet (2 formats 500x300 mm²)

4.3 MOULD MANUFACTURES OF THE STRUCTURES

4.3.1 Cores

96 aluminium identical alloy cores 261Å T851 with surface treatment chemical nickel following datum-line GLT-LLR-10-03

Classification At year end in the form: X-yy, with

X varying from 1 to 8, number of the to bush-hammer

Varying YY from 1 to 12, number of cell of the to bush-hammer

Classification defines has single position in the mould for each core

4.3.2 Steam pressing bars

16 alloy bars of aluminium 261Å T851, divided into 4 types of shares:

- 2 bars for to bush-hammer 1 datum-line following GLT-LLR-10-10
- 2 bars for to bush-hammer 8 datum-line following GLT-LLR-10-11
- 4 bars for layers with 2 side inserts according to plane GLT-LLR-10-08
- 8 bars for layers with 3 side inserts according to plane GLT-LLR-10-09

4.3.3 Bars of end

16 alloy bars of aluminium 261Å T851, divided into 3 types of shares:

- 2 bars for to bush-hammer 1 datum-line following GLT-LLR-10-13
- 2 bars for to bush-hammer 8 datum-line following GLT-LLR-10-14
- 12 bars for layers 2 to 7 datum-line following GLT-LLR-10-12

4.3.4 Bars in composite

8+8 Bars in composite carbon fibre and epoxy resin used for the positioning of the side inserts of the structure

- Composite bar standard A (for positioning on layer with 2 inserts) GLT-LLR-10-06
- Composite bar standard B (for positioning on layer with 3 inserts) GLT-LLR-10-07

4.3.5 Plates in composite

1+1 Plates in composite carbon fibre and epoxy resin used for the positioning of the higher and lower inserts of the structure

- Plate composite lower GLT-LLR-10-04
- Plate composite higher GLT-LLR-10-05

4.3.6 Bed plate

Bed plate of the aluminium alloy mould 2017A T451: GLT-LLR-10-15

4.3.7 Angles

4 following aluminium alloy angles 2017A manufacturing drawing T451 GLT-LLR-10-17.
The angles will be fixed on the bed plate of the mould by screws and will be dismounted only in the event of difficulty to clean the resin burs

4.3.8 Side plates

4 following aluminium alloy plates 2017A manufacturing drawing T451 GLT-LLR-10-18

4.3.9 Lid

Lid of the aluminium alloy mould 2017A T451: GLT-LLR-10-16

4.3.10 Teflon Rings

25 Teflon rings of positioning of the lower inserts in the lower composite plate, following manufacturing drawing GLT-LLR-10-19
16 Teflon rings of positioning of the higher inserts in the higher composite plate, following manufacturing drawing GLT-LLR-10-20

4.3.11 Seals out of silicone

192 red silicone joints

4.3.12 Screws and bolts

4.4 AUTOCLAVE

5. DATA PROCESSING

5.1 ANOMALIES

Any anomaly detected by the team will be the subject of a card of anomaly.

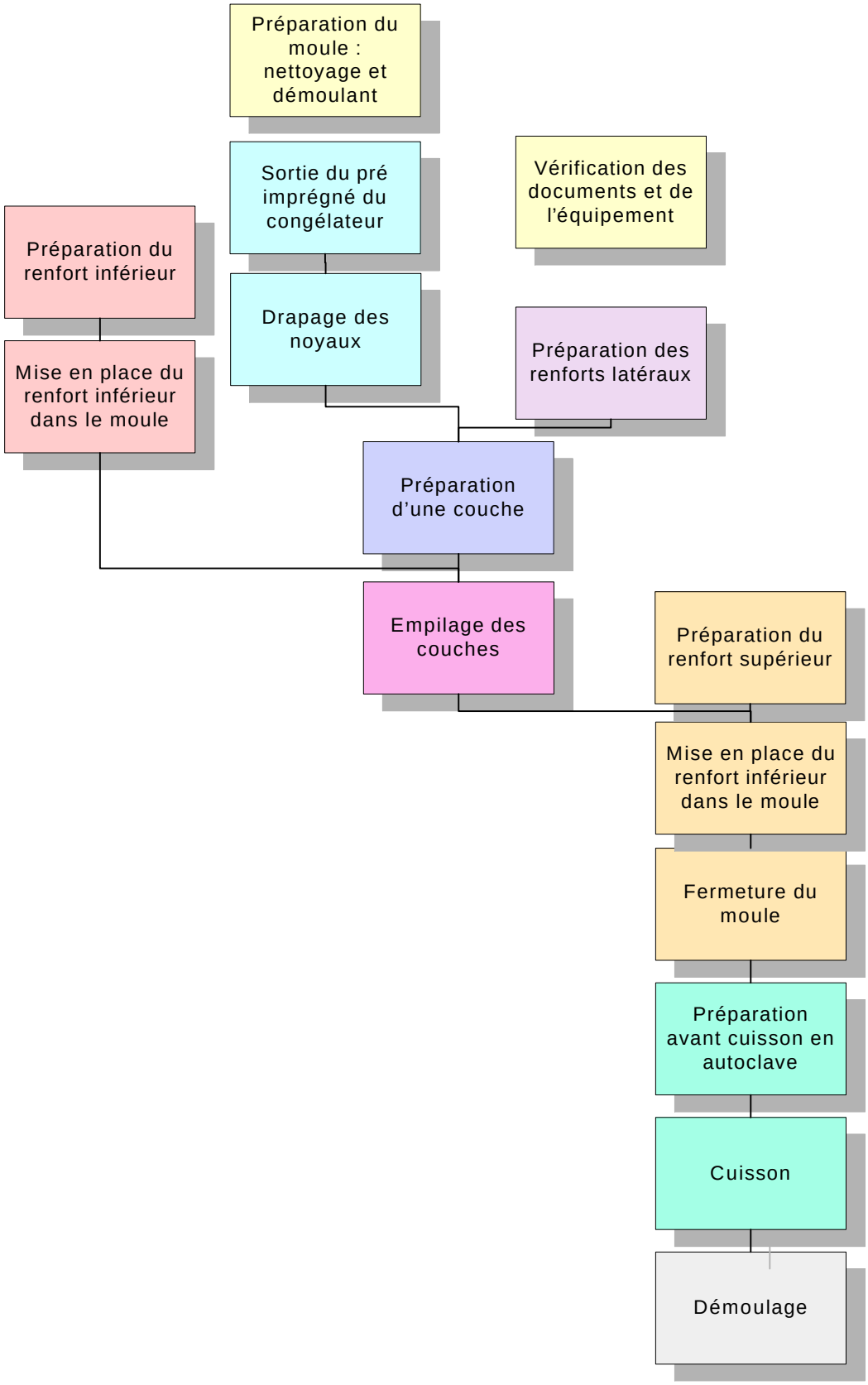
5.2 RECORDING OF THE FOLLOW-UP OF MANUFACTURE

All the data collected during the activities of test and/or integration will have to be recorded
They will include moreover:

- The "Ace run" of the procedure
- photographs,
- cards of anomalies.
- the monitoring sheet of pre impregnated
- the update of **the Following Booklet (Log Book)**

6. PROCEDURE

The procedure of manufacture of the structures in composite includes several phases which will be carried out in different environments.



7. PROCEDURE OF CHECKING

The various phases of preparation and manufacture are detailed in the following pages.

This phase includes the following operations:

- Checking of the presence of the documents and their validity
- Checking of the tools and the equipment
- Checking of the conformity of the pre cuttings impregnated one
- Checking of the conformity of the titanium alloy inserts

Specific checks will be carried out at the various stages of manufacture.

Num. Oper.	Description de l'opération	Procédure / Réf. feuille résult. ou commentaires
	VERIFICATIONS DES DOCUMENTS	
	• Vérifier la présence des documents mentionnés au § 2.1. • Vérifier que les composants sont munis de leur certificat de conformité.	
	VERIFICATION DE L'OUTILLAGE	
	• Vérifier la présence de l'outillage listé dans le document GLAST-LLR-LI-075	
	VERIFICATION DES INSERTS	
	• Vérifier la propreté des inserts • Vérifier le filetage d'un insert sur 5	

8. PROCEDURE OF PREPARATION OF THE MOULD

8.1 DRANK

Cleaning then application of the release agent on the parts of the tools in order to allow an easy release from the mould of the structure in composite after polymerization.
Assembly of the parts.

8.2 ENVIRONMENT

Workshop of mechanics of the LLR

8.3 PARTS TO BE PASSED TO UNMOULDING

- Together parts of the aluminium alloy mould
- Together parts of the mould in composite
- Screws and bolts

The rings out of Teflon and silicone joints are not treated.

8.4 FREQUENCY

The passage of unmoulding will be carried out with the following frequency

- Before the manufacture of structure 1
- Before the manufacture of structure 2
- Before the manufacture of structures 5, 8, 11, 14, 17

After each release from the mould of structure, the parts will be cleaned as described hereafter then checked. If necessary, of the additional treatments could be carried out on certain parts.

8.5 OPERATIONS

Num. Oper.	Description de l'opération	Procédure / Réf. feuille résult. ou commentaires
	NETTOYAGE DES PIECES	
	• Before the first use, the parts must be degreased perfectly with acetone then cleaned with industrial alcohol (ethanol) • To ensure itself of their cleanliness • After a manufacture, to remove each part from any resin run-out by scraping them using a PVC strip in order to avoid all stripes • To clean the parts with industrial alcohol To arrange each core in limps and with the adequate position	
	TRAITEMENT AU DEMOULANT	
	• To make sure that the expiry date of unmoulding is not exceeded • To pour unmoulding it in a clean polyurethane container • Slightly to soak with unmoulding a rag clean, nonfluffy, and to uniformly apply it to all the surface of the parts. • To make sure that the chamfers of the cores, drillings and tappings	

Num. Oper.	Description de l'opération	Procédure / Réf. feuille résult. ou commentaires
	are also treated, to use a brush to apply unmoulding it in drillings and tappings • To leave unmoulding it to dry 30minutes then to apply a new layer To let dry during 30 minutes then to arrange all the parts in order to limit their exposure to dust	
	RANGEMENT DES PIECES	
	• The cores are treated directly in their limps support, to close limp them as soon as the application of unmoulding is finished • To arrange the pressing bars and the bars of ends in their respective boxes • To cover the parts with big size of a plastic film in order not to expose them to dust • To bag the parts of small size The whole of the parts returned in clean room	
	ASSEMBLAGE (figure 0)	
	• To assemble the 4 angles on the bed plate of the mould To ensure itself of their perfect perpendicularity compared to the plate	

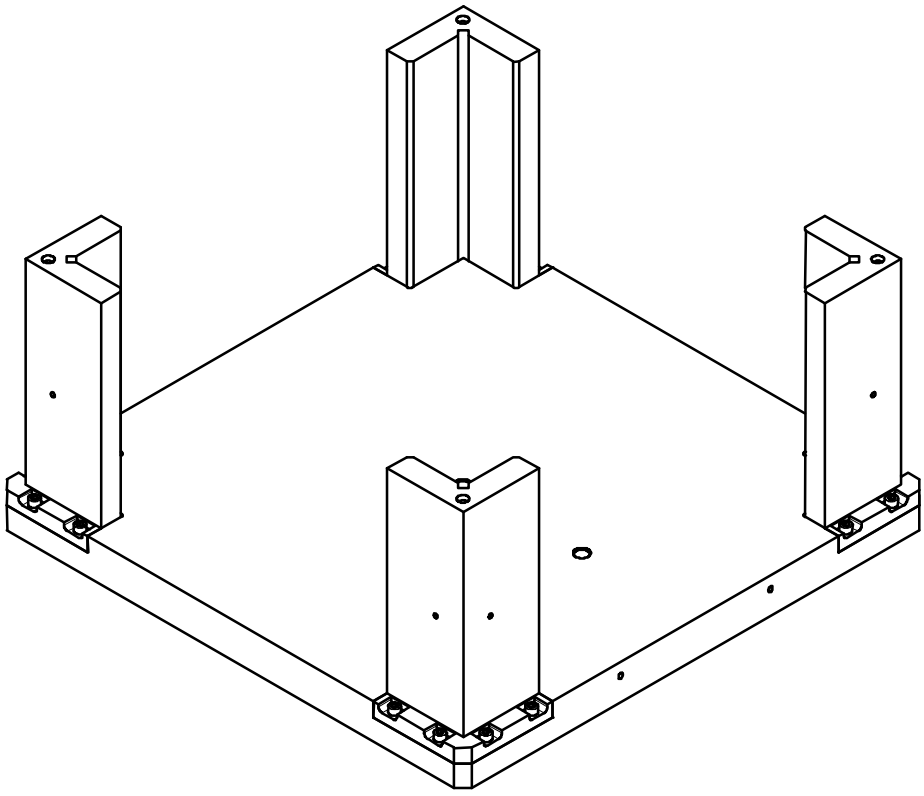


fig. 0

9. ASSEMBLY

9.1 DRANK

To carry out draping and the assembly of pre impregnated for the realization of the composite structure, by using the tools of moulding.
This phase is carried out in the clean room.
It includes the following operations:

- Defrosting of the pre cuttings impregnated one
- Preparation of layers 1 to 8
  - Winding of the cores
  - Preparation of the side reinforcements
  - Draping of the layers
- Preparation of the reinforcements inferior and superior
- Stacking of the layers and reinforcements in the tools
- Preparation for the vacuum setting

9.2 ENVIRONMENT

Clean room of the LLR

9.3 ELEMENTS CONCERNED

- Pre cuttings impregnated the, detailed ones in the document of specifications GLAST-LLR-sp-035
- Titanium alloy inserts:
  - 25 lower inserts, following manufacturing drawing GLT-LLR-00-05
  - 16 higher inserts, following manufacturing drawing GLT-LLR-00-04
  - 40 side inserts, following manufacturing drawing GLT-LLR-00-03
- The whole of the parts of the mould

9.4 EXIT OF THE DECOUPES OF PRE IMPREGNÉ

The pre impregnated one must have left the freezer and have defrosted before use according to the procedure GLAST-LLR-Pr-068

9.5 PREPARATION OF THE REINFORCEMENT INFERIOR

9.5.1 Drank

To carry out the assembly of stackings and inserts lower on the lower composite plate of the mould

9.5.2 Elements concerned

- The pre stackings impregnated one:
  - Lower stackings 1 EI1
  - Lower stackings 2 EI2
- Parts of the tools:
  - Plate composite lower GLT-LLR-10-04
  - 24 Téflon rings of positioning of the lower inserts GLT-LLR-10-19
  - 1 ring Teflon of position of the central lower insert GLT-LLR-10-23
- 25 lower inserts titanium: GLT-LLR-00-05
- The bed plate of the mould
- 1 pin of positioning

9.5.3 Specific tools

- Roller for compaction

9.5.4 Operations

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MISE EN PLACE DES INSERTS (figures 1-1 et 1-2)	
	• To open the plastic sachets protecting stackings EI1 and EI2 • To supply 25 lower inserts • Oter paperboard of protection on the face 45° (registered on protection) of stacking EI1 • To position the square base plate of the 25 inserts in cuttings of stacking EI1 • To withdraw the second sheet of protection • To check that there does not remain piece of paper of protection on the pre in particular impregnated one around the inserts • Oter paperboard of protection on the face 0° of stacking EI2 • To apply stacking EI2 to stacking EI1 while making gradually pass the cylindrical part of the 25 inserts in drillings of diameter 8mm • Oter paperboard of protection on the face on which the cylindrical parts of the inserts are located To bind two stackings by applying to surface a pressure to the hand	

POSITIONNEMENT DES INSERTS

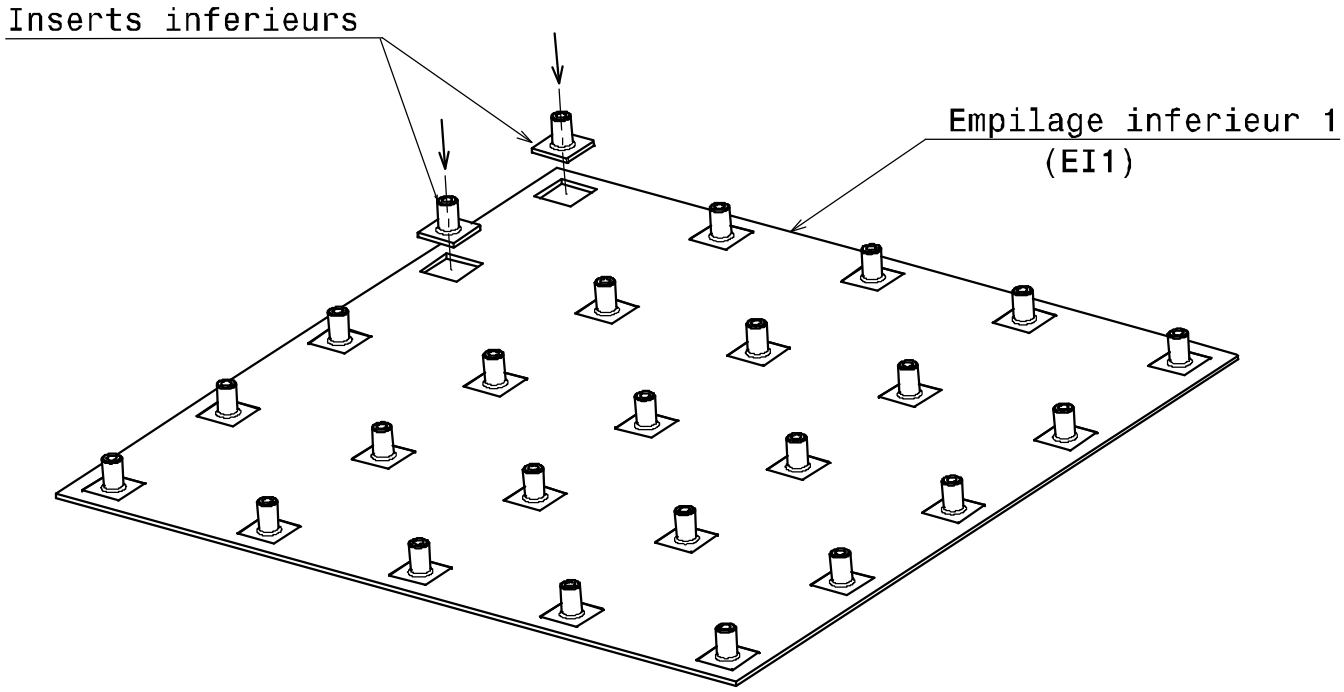


fig. 1-1

POSITIONNEMENT DE L'EMPILAGE INFERIEUR 2 SUR
L'EMPILAGE INFERIEUR 1

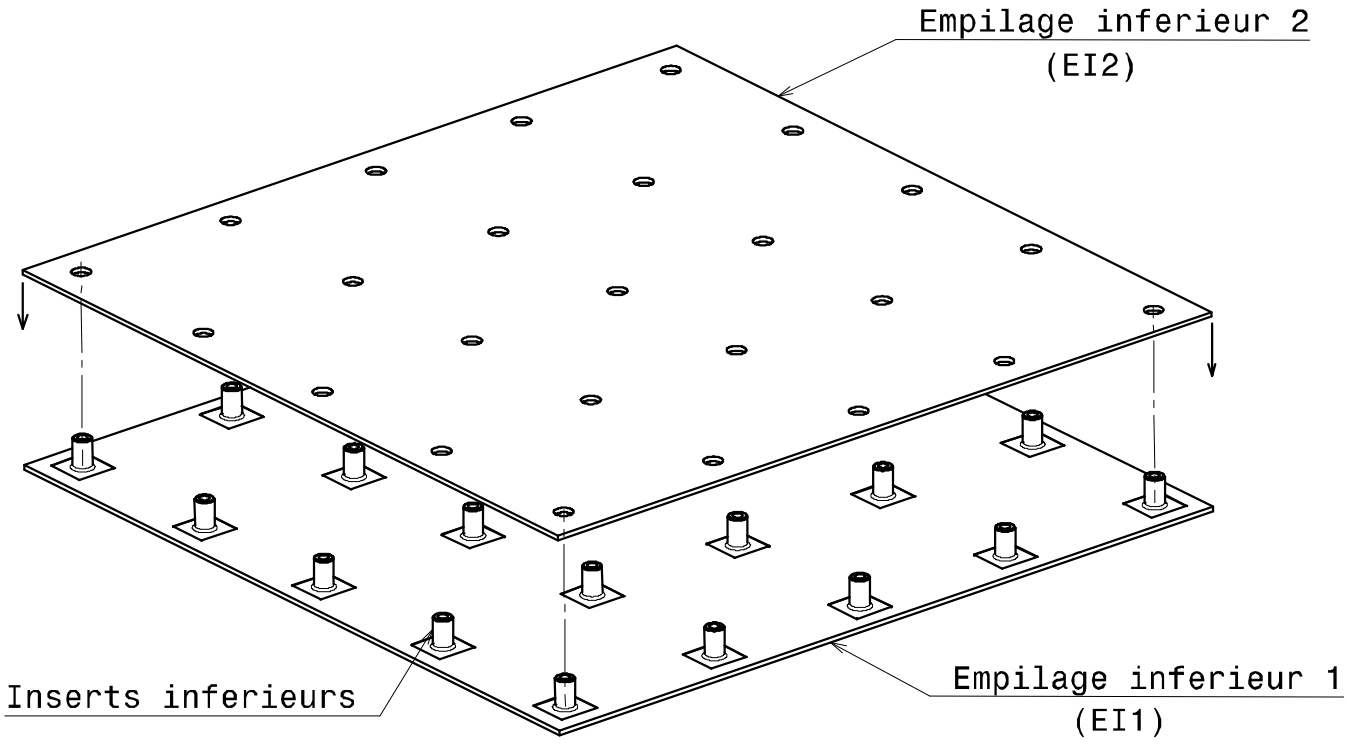


fig. 1-2

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MONTAGE SUR LA PLAQUE COMPOSITE (figures 2-1, 2-2 et 3)	
	• To open the sachets containing the rings Teflon for the lower inserts • To mount a ring on the cylindrical parts of two inserts of corner diametrically opposite. The rings must be brought in contact with pre impregnated • To assemble the unit on the composite plate inferior (with dimensions with grooves on the circumference) by using the two inserts with rings as pawns of positioning • To turn over the unit and to set up the other Téflon rings longest must be assembled on the central insert. The rings must be inserted until levelling the higher face of the composite plate If the rings Teflon do not return to check that the insert is well positioned right (if not to rectify it using a screw), then renter using a mallet.	

MONTAGE DES DEUX PREMIERES BAGUES TEFLON

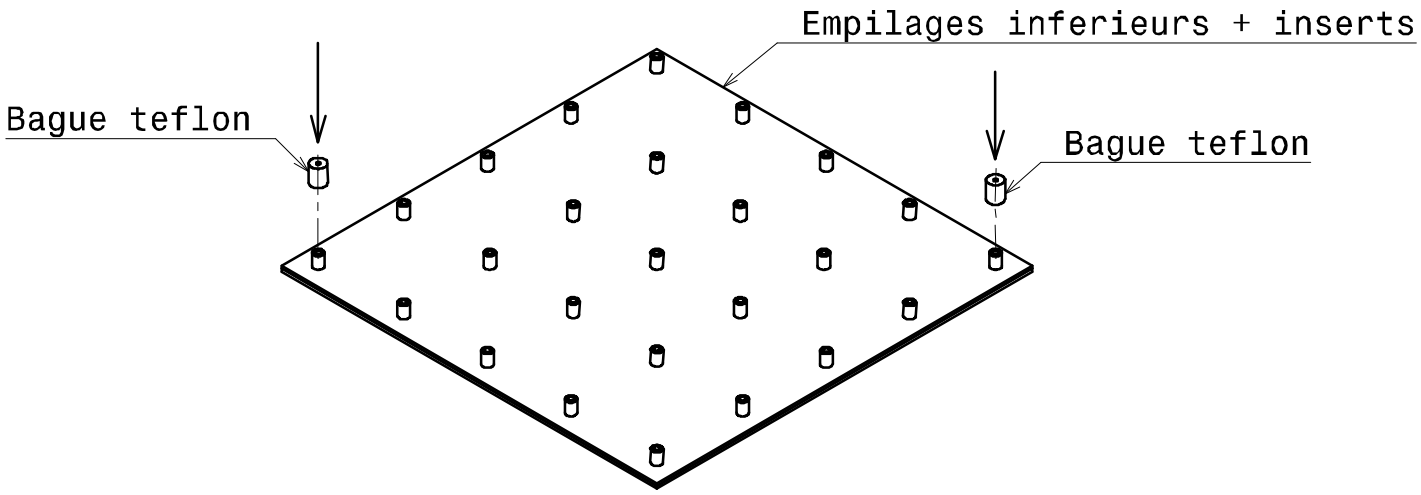


fig.2-1

MONTAGE SUR LA PLAQUE COMPOSITE

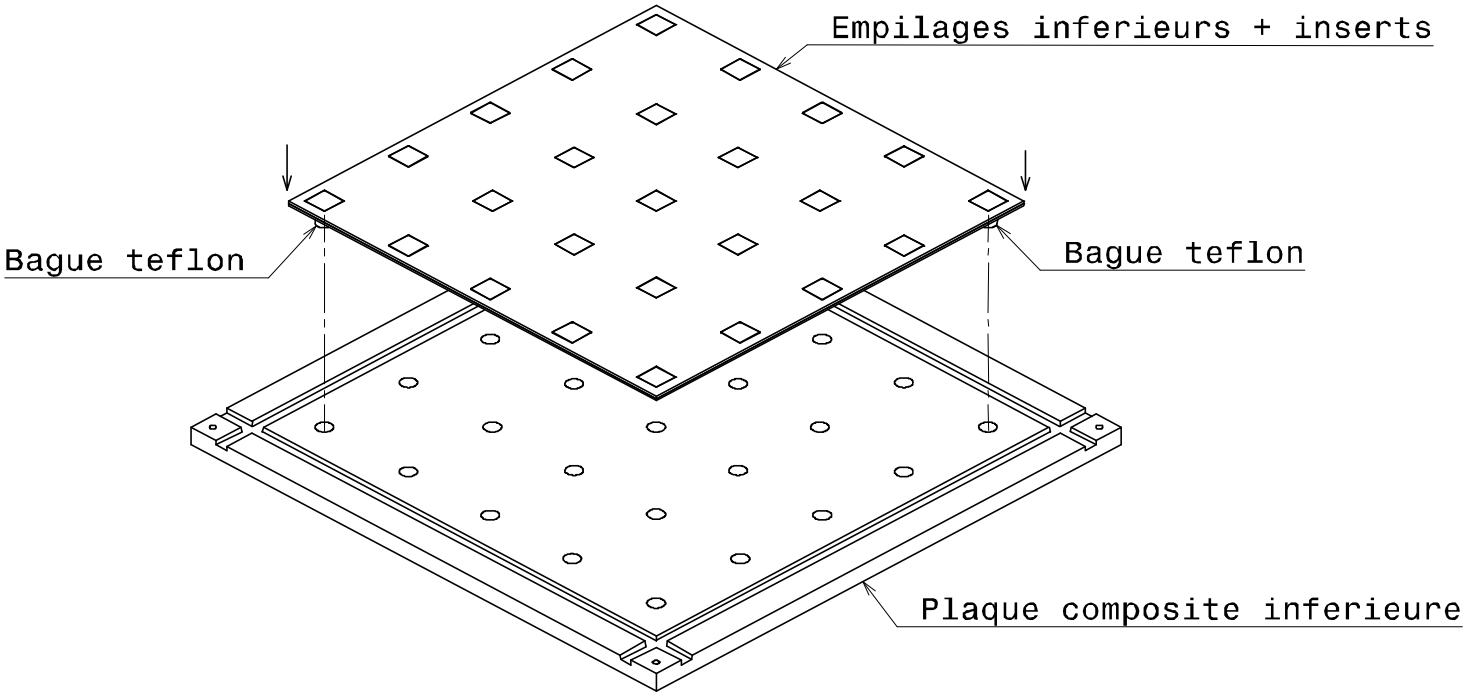


fig. 2-2

MONTAGE DES BAGUES TEFLON RESTANTES

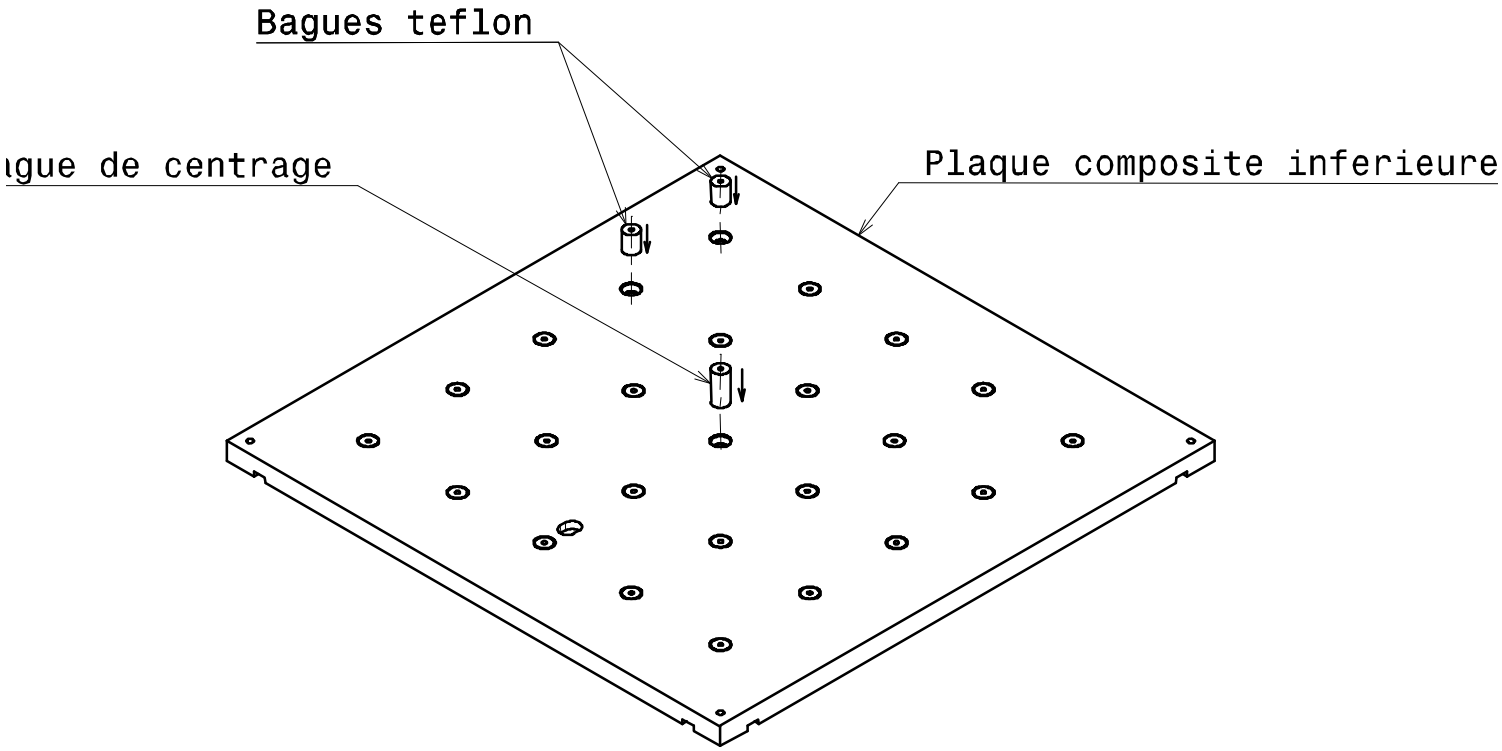


fig. 3

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MONTAGE SUR LA PLAQUE DE BASE DU MOULE (figure 4)	
	• To mount the pin on the bed plate (noncentral hole) To position lower the reinforcement unit on the bed plate of mould. The ring Teflon of the central insert and the pin assembled on the bed plate are used for positioning of the composite plate of the tools. Markings X+, X -, Y+ and y of the composite plate must coincide with those of the bed plate	

MONTAGE SUR LA PLAQUE DE BASE DU MOULE

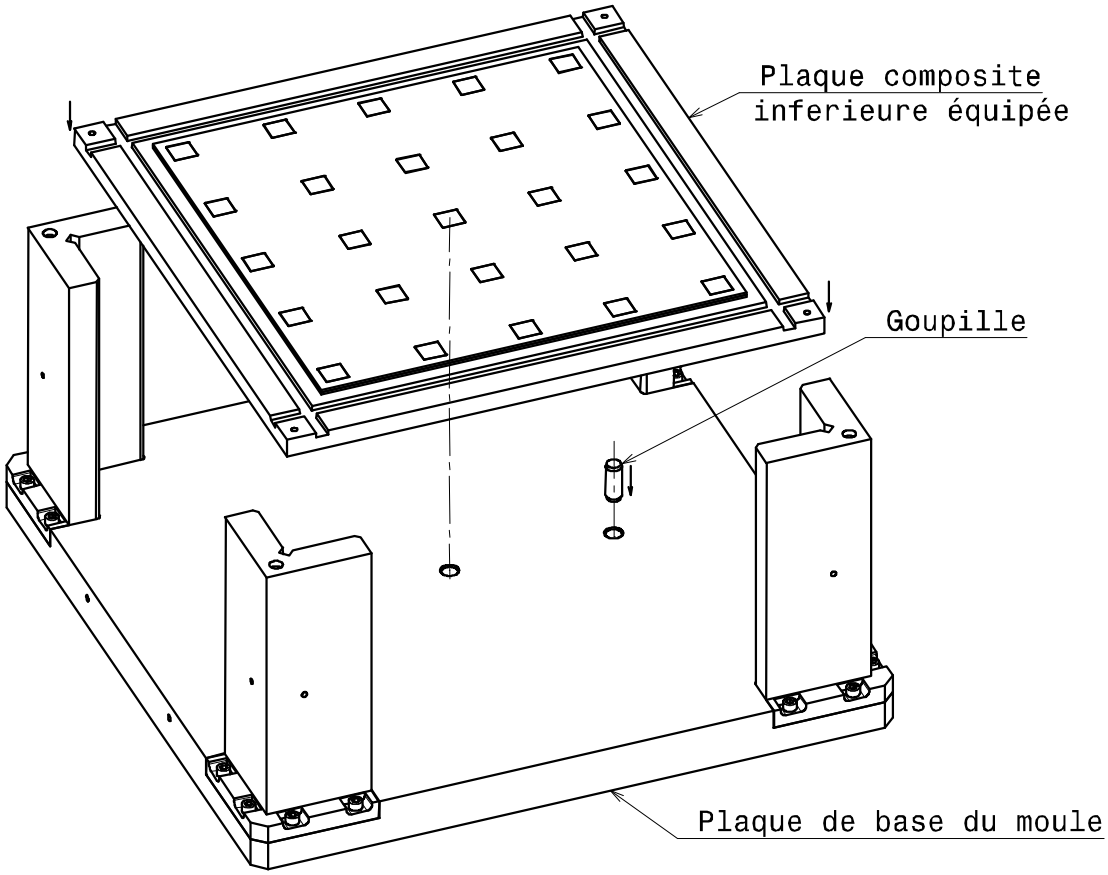


fig. 4

9.6 DRAPING OF THE CORES

9.6.1 Drank

To wind cuttings pre impregnated PEN (Fold Coating Core) on the 96 cores of the tools and to set up the intercalated folds between cores PIN (Intercalated Fold Cores)

9.6.2 Elements concerned

- 96 cores of the mould to be wound with folds PEN
- Cores 02 to 12 of each layer for the installation of folds PIN
- Cuttings pre impregnated PEN and PIN
- Cylindrical silicone joints of protection of tappings of the cores

9.6.3 Specific tools

- Foam neoprene cuttings being used as surface of winding
- Carpet of cutting urethan for setting with length of pre impregnated
- Cutter and blades for cutting of pre impregnated

9.6.4 Operations

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	SEQUENCE	
	• The cores must be wound sequentially: sleeps 1 to 8 and core 1 to 12. Before starting the winding of a series of cores, to check that the 6 cores contained in the boxes were correctly arranged there (number of the cores indicated by labels on limp and supports of cores) **To always wind the cores in order to have all the numbers in the same direction**	
	BOBINAGE DES PLIS PEN (figures 5-1 et 5-2)	
	• To open the plastic sachet containing the folds of pre impregnated PEN • Oter the hard-bound protection of the fold pre impregnated PEN • To roughly position the fold in the medium of one of two the small with dimensions ones of the cores while ensuring itself of an overflow from 1 to 2 mm at each end of the cores. To apply the fold well to the surface of the core. • To continue the winding of the core on the neoprene foam sheet by marking the angles carefully • The pre impregnated one wound should not present covering: in the event of light defect, to make play the deformability of fabric to obtain a jointed connection	

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	• Winding must be jointed: the tolerated maximum clearance must remain lower than 1 mm • To withdraw the screws of the cores • To cut out the surplus of pre impregnated on the ends of the cores. The end of the core is used as bearing surface: the operation must carefully be made in order to avoid notching metal • To install the cylindrical joints silicone in facings at each end of the cores To always position the cores on the scheme of work resting against the face with joint for the cores. To place the cores sequentially 01/02/… /12 with the end with marking always of very with dimensions	

ENROBAGE DES NOYAUX

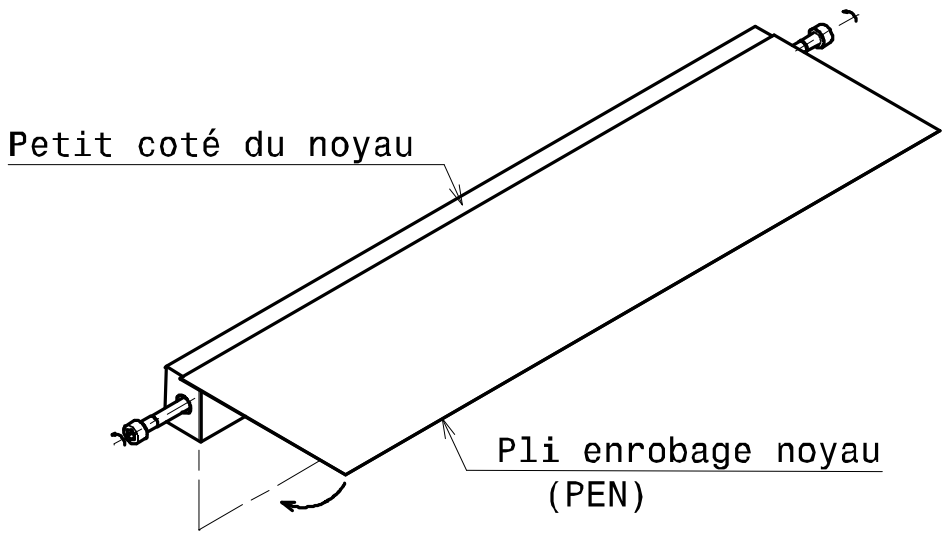


fig. 5-1

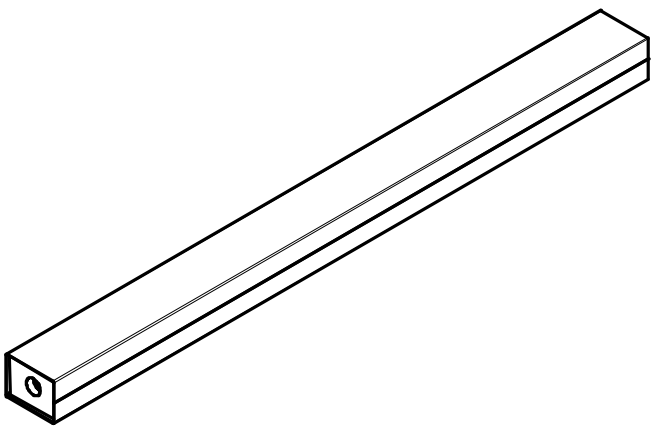


fig. 5-2

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MISE EN PLACE DES PLIS PIN (figure 6)	
	The operation relates to only cores 02 to 12 of each layer • To open the plastic sachet containing the folds of pre impregnated PIN • To take off the plastic film of protection of fold PEN wound on the core on the face of the core where is done the joint of pre impregnated • Oter the plastic film of protection of the intercalated fold core PIN • To position fold PIN by centering it on the face of the core. To preserve an overflow from 1 to 2 mm at each end Carefully to apply the fold to surface to the hand	

MISE EN PLACE DES PLIS INTERCALAIRES

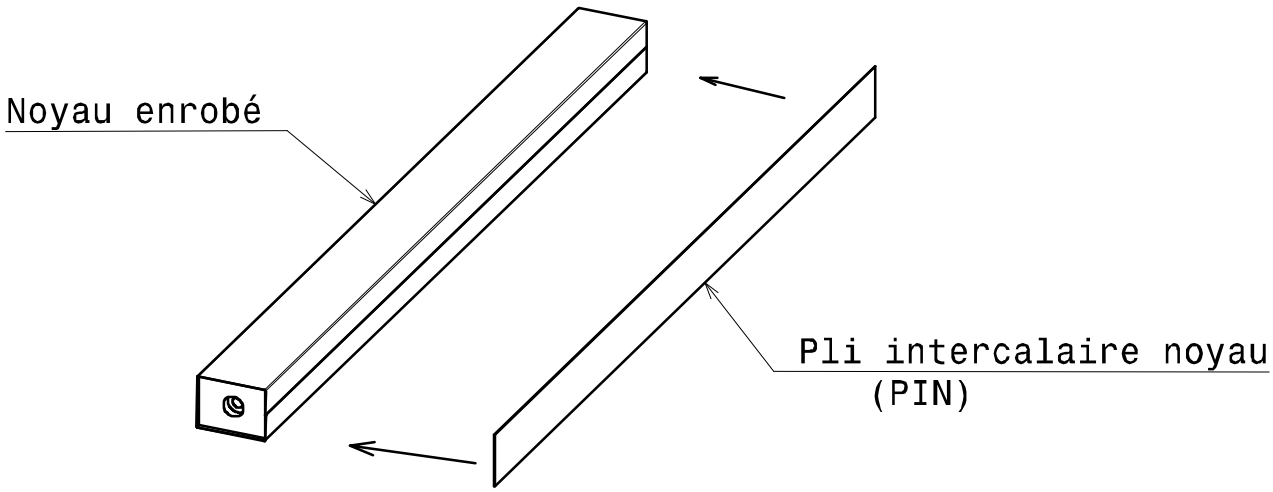


fig. 6

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	FINITION	
	• To cut out the overflows of pre impregnated PIN at each end of the core using a cutter. The end of the core is used as bearing surface: the operation must carefully be made in order to avoid notching metal • To always position the cores on the scheme of work resting against the face covered by fold PIN or on the face with joint for cores 01. To place the cores sequentially 01/02/… /12 with the end with marking always of very with dimensions **To regularly clean the carpet of cutting with alcohol**.	

9.7 PREPARATION OF THE SIDE REINFORCEMENTS

9.7.1 Drank

To carry out the side assembly stackings and inserts on the bars composite of the mould

9.7.2 Elements concerned

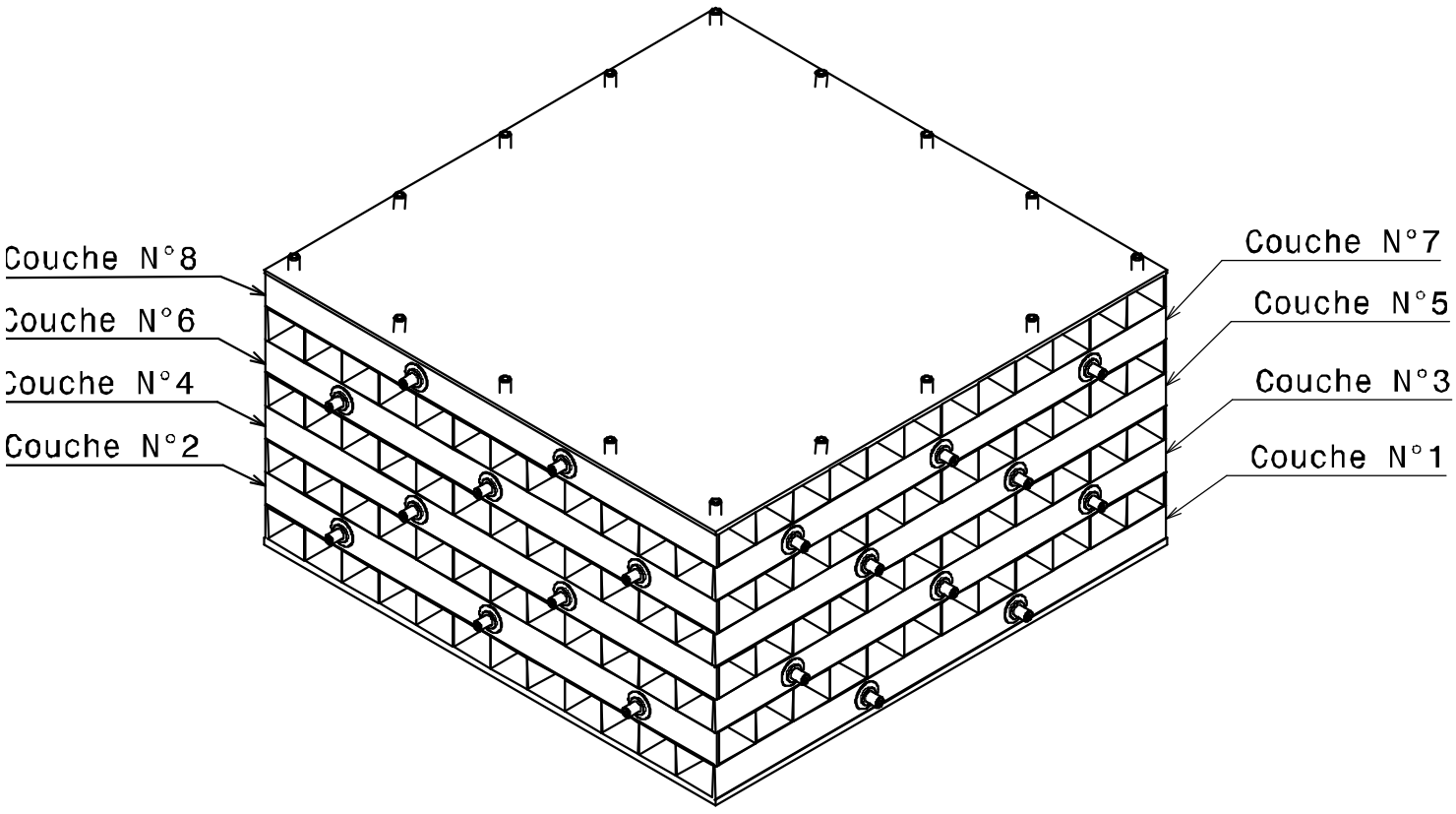
- The pre stackings impregnated one:
  - 16 Side Stackings AB; ELAB
  - 8+8 side Stacking standard A and B ELA and ELB
- 40 side titanium inserts: GLT-LLR-00-03

9.7.3 Eléménts prepared

- Wound cores 01 and 12 of the layer being prepared

9.7.4 Specific tools

- Carpet of cutting urethan for setting with length of pre impregnated
- Cutter and blades for cutting of pre impregnated
- Bars in composite of the EM 2 and 3 holes



9.7.5 Operations

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	SEQUENCE	
	• The composite classification of the bars comprises a number of layer (1 to 8) and signs it "+" or "-" making it possible to differentiate the 2 parts from each layer. • To check that the parts used are those of the layer in progress • To position the composite bar so that its number is readable at the place.	
	EMPILAGE DU PRE IMPREGNE (figure 7)	
	• To open the plastic sachets containing stacking ELAB, ELA and ELB • To supply the number of side inserts according to the type of layer being prepared: sleep to 2 or 3 inserts • Oter the paper of protection on one of the faces of stacking ELA (respectively ELB): Symmetrical stackings • To pose stacking on one of the bars composite of the corresponding EM • To position the inserts in drillings diameter 10 by making sure that the square base plate is directed the edges of stacking parallel to • To carefully apply to the pre hand impregnated one around the cylindrical part of the inserts • Oter the paper of protection on one of the faces of stacking ELAB: Symmetrical stacking • To cover the base plate with the inserts with stacking ELAB while carefully making coincide edges with those of stacking ELA (respectively ELB) • To compact while turning over the composite bar	

PREPATION DES RENFORTS LATERAUX

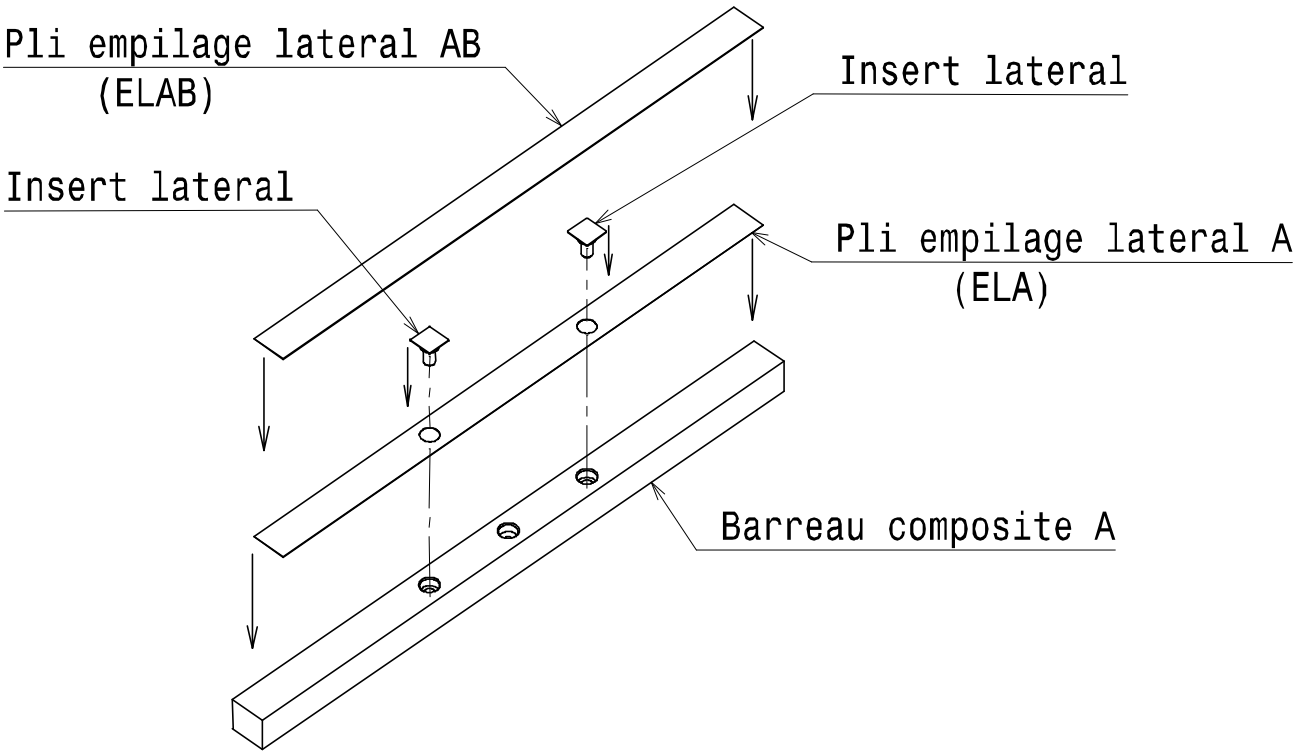


fig. 7

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	ASSEMBLAGE AVEC LES NOYAUX (figure 8)	
	• Oter the plastic film of protection of pre impregnated on core 01 of the layer in progress • To apply carefully by centering it side the stacking unit (ELAB + ELA/B + inserts) to the face of the core (side joint of the fold wound PEN). • The edges of side stacking must coincide with those of the wound core and the overflows at each end must be identical • Oter the plastic film of protection of pre impregnated on core 12 of the layer in progress • To carefully apply the second side stacking unit to the face of the core opposed to that covered by fold PIN • ***The pre impregnated one not protected by plastic film or the paperboard should never be posed directly on the schemes of work. To take care always to preserve a cutting of film or paperboard of protection to use it like bearing surface***	

ASSEMBLAGE DES RENFORTS LATERAUX SUR LES NOYAUX

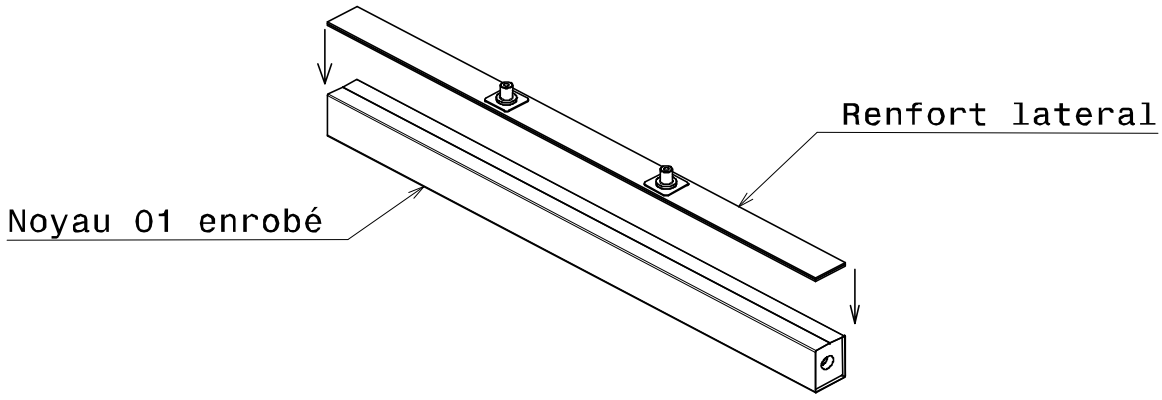


fig. 8

9.8 PREPARATION OF A LAYER

9.8.1 Drank

To carry out the complete assembly of a layer of the mould: 12 side cores and reinforcements with inserts to be bound together using the folds of pre impregnated layer

9.8.2 Elements concerned

- The pre stackings impregnated one:
  - 8+8 side folds lay down standard A and B PLCA and PLCB
  - 16 interior folds sleep PEAK
  - 16 external folds sleep PEC
  - 7 intercalated folds layers PEAK
- Parts of the tools:
  - 12 Bars of end AB for layer 2 to 7 GLT-LLR-10-12
  - 2 Bars of end 1 for layer 1 GLT-LLR-10-13
  - 2 Bars of end 8 for layer 8 GLT-LLR-10-14
  - 4 pressing Bars A for layers 4 and 5 (2 inserts) GLT-LLR-10-08
  - 8 pressing Bars B for layers 2,3,6 and 7 (3 inserts) GLT-LLR-10-09
  - 2 pressing Bars 1 for layer 1 GLT-LLR-10-10
  - 2 pressing Bars 8 for layer 8 GLT-LLR-10-11
  - 8 composite Bars type A (layer 2 inserts) GLT-LLR-10-06
  - 8 composite Bars type B (layer 3 inserts) GLT-LLR-10-07
  - 16 central studs for inserts
- Screws and bolts of work-holding
  - 32 screws CHC M5x30 with discs for fixing of the pressing bars on the bars of ends cores
- Joints silicone of protection of the fastening screws of the pressing bars and ends

9.8.3 Prepared elements

- Wound cores 01 to 12 of each layer
- Side reinforcements assembled on cores 01 and 12

9.8.4 Specific tools

- Carpet of cutting urethan for setting with length of pre impregnated
- Cutter and blades for cutting of pre impregnated
- Tally of compaction of the layer of cores + 2 Aluminum bars + 1 pressing bar + 2 rails
- Reglet 500 mm
- Key for screw CHC M5

9.8.5 Opérations

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	PREPARATION DU CADRE DE COMPACTAGE	
	• To position the framework in an angle of the marble • To fix using Scotch tape Teflon the rails (perpendicular to the positioning of the pressing bar) • To fix the framework on the marble with screw clamps  	
	COMPACTAGE DES NOYAUX (figures 9 et 10)	
	• To position a bar aluminium resting against the right side of the framework (to avoid the round-off of the framework during the compaction of the cores) • To position the composite bar unit of EM + side reinforcement + core n°1 within the framework by using one of the ends like surfaces reference • Successively to position the cores within the framework. The ends numbered of the cores must be systematically positioned the same one dimensioned and in the same direction for all the cores • To compact the whole within the framework. The dimension between the two side reinforcements must be roughly 338mm. Contrôler the dimension using a reglet	

MISE EN PLACE DES NOYAUX POUR LE COMPACTAGE

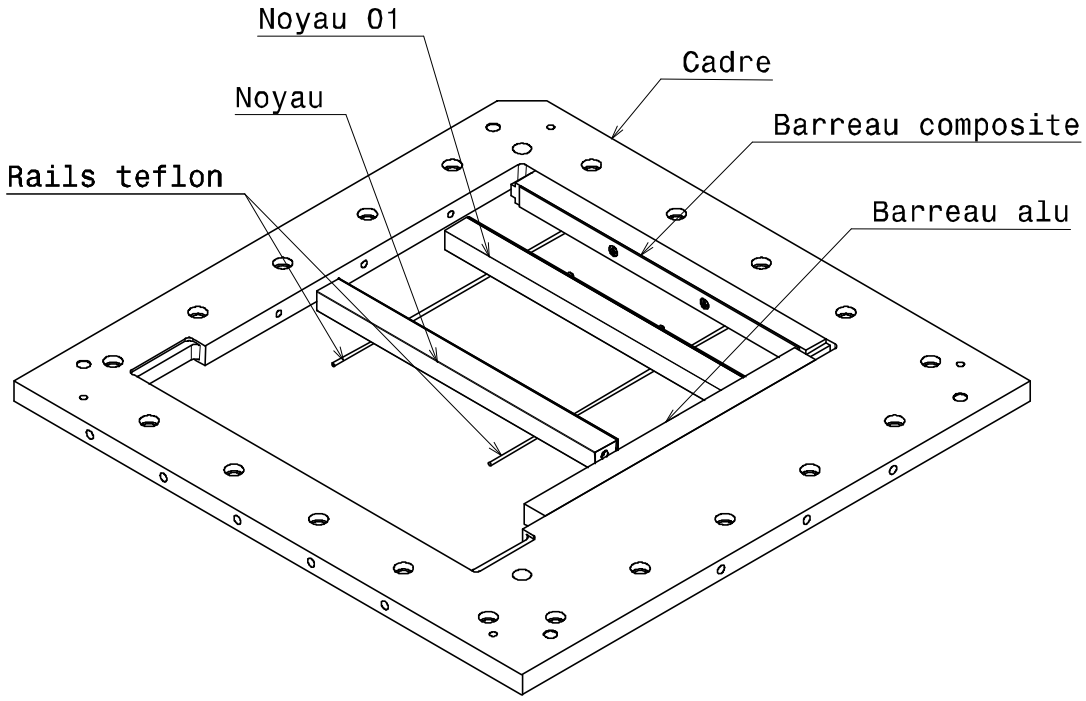


fig. 9

COMPACTAGE DES NOYAUX

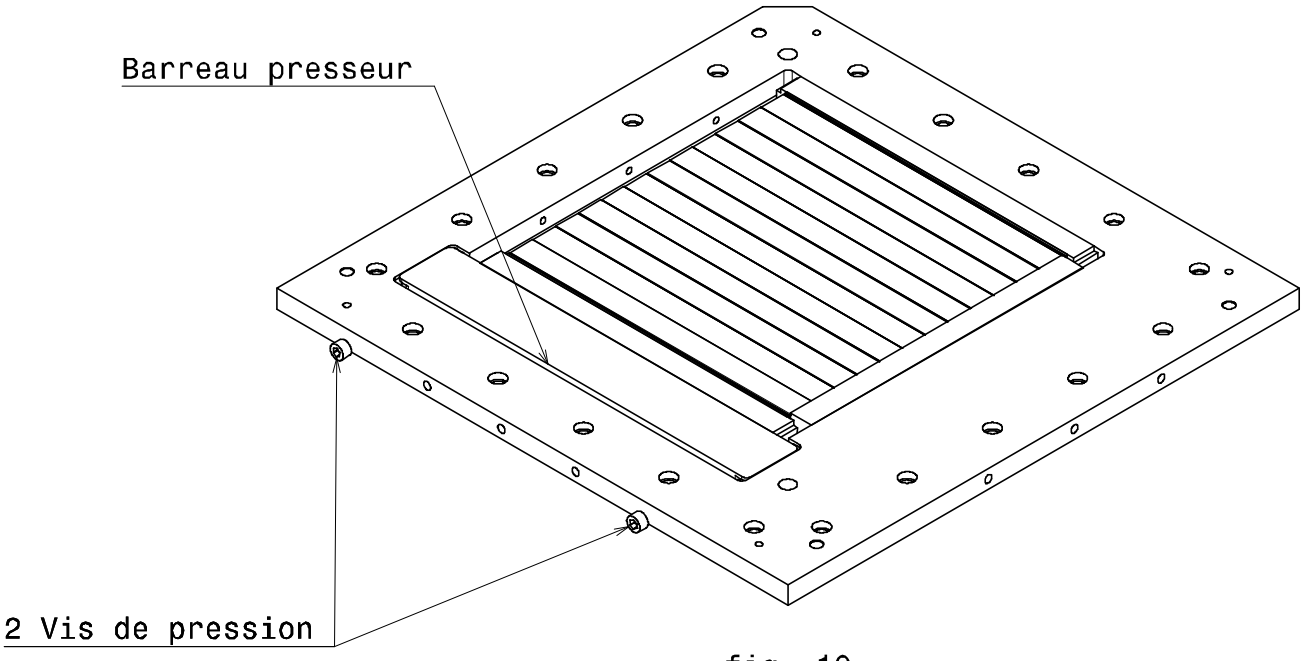


fig. 10

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MISE EN PLACE DU PLI INTERIEUR COUCHE PIC (figure 11)	
	• Oter the plastic film of protection of an interior fold lays down PEAK • To apply the fold to the surface of cores while taking care to position the dimension of 340mm (great dimension) according to the length of the cores. To balance the overflow at each end of the cores. • To suitably plate the fold using a roller • To stop the compaction of the cores and to turn over the layer within the framework • To again compact the whole with the dimension of 338 • To set up the second interior fold sleeps in the same way that the first • To stop the compaction and to leave the layer cores the framework	

MISE EN PLACE DES PLIS INTERIEUR COUCHE

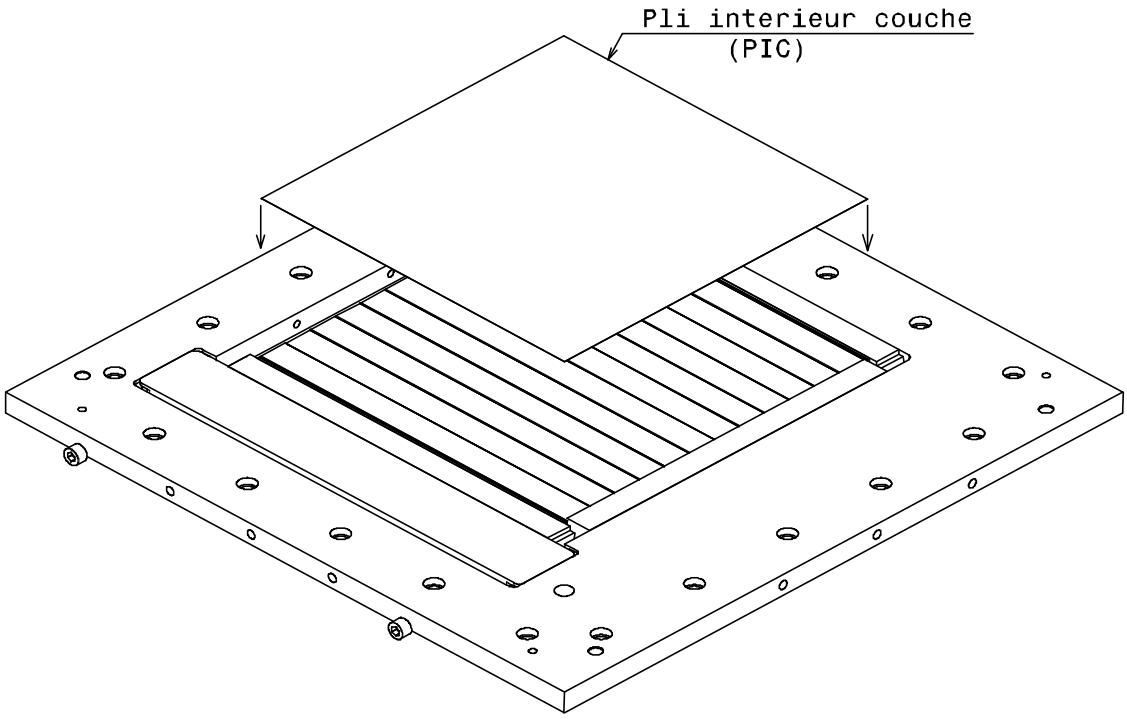


fig. 11

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	DRAPAGE DES PLIS LATERAUX COUCHE (figure 12)	
	• To withdraw the bars composite of the EM of the side reinforcements • Oter the paperboards of protection on one of the side reinforcements and a side fold sleep (PLCA or following PLCB sleep to 2 or 3 inserts) • To pose the block on the edge of the marble • To apply the side fold to the reinforcement by formatting well the zones around the inserts • Oter the paperboard of protection of the interior folds sleeps. To preserve the paperboard to use it as protection to avoid the contact between the pre one impregnated and the scheme of work • To fold back the side fold sleep on the interior folds sleep, above and below using the bars composite • To proceed in an identical way for the other side	

MISE EN PLACE DES PLIS LATERAUX

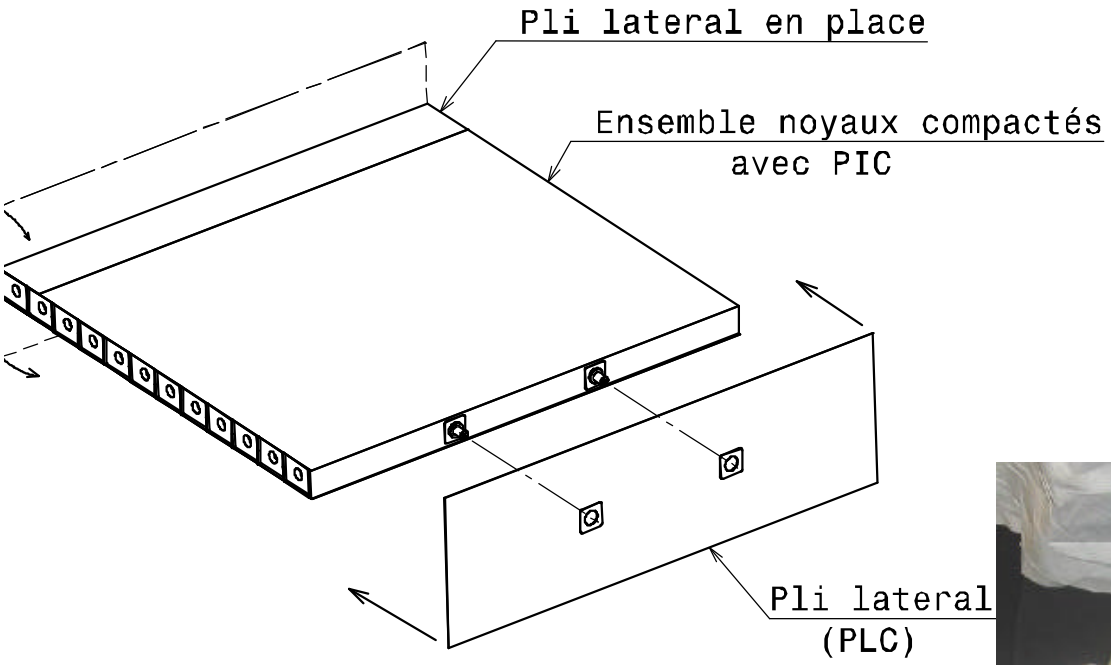


fig. 12

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MISE EN PLACE DES PLIS EXTERIEURS COUCHE (figure 13)	
	• Oter the film of protection of the external fold sleeps • To apply the fold external layers between the two reductions of the PEC. To balance the play as well as possible • To cut out using a cutter the pre overflows impregnated one with herring barrel end of the layer (by repositioning the bars composite of the EM on the level of the inserts)	

MONTAGE DES PLI EXTERIEURS COUCHE

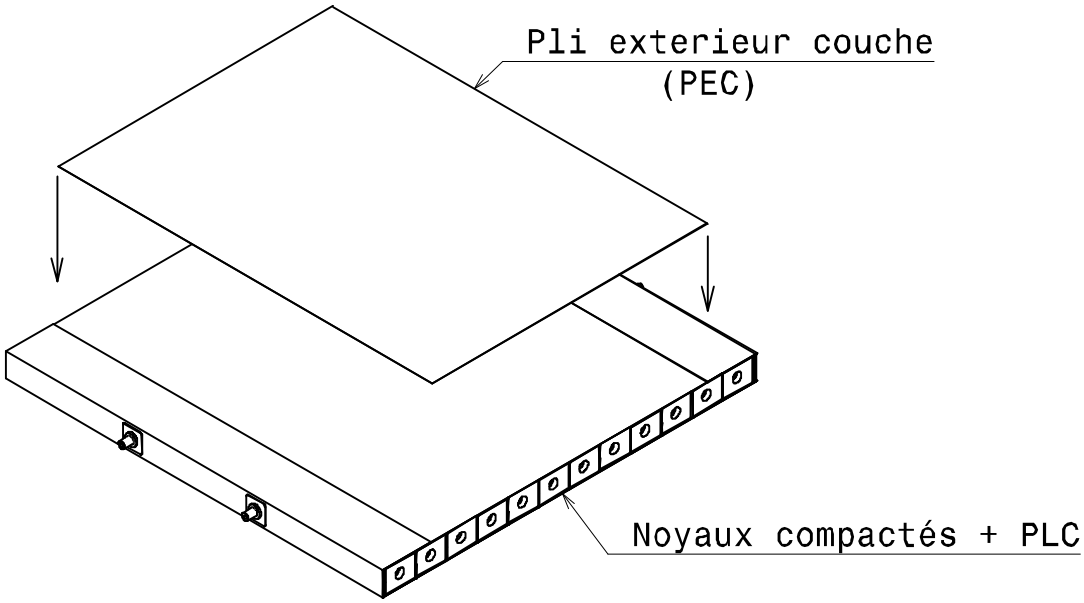


fig. 13

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	ASSEMBLAGE DES BARREAUX (figures 14-1 et 14-2)	
	• To encase the bars composite with the pressing bars using the central studs ((to make correspond references of the bars: n° of layer and orientation X, Y) • To put in support the bars of end against the end of the cores • To set up the composite bar unit + pressing bar on the inserts • To install the screws M5x30 in the holes lamés at each end of the pressing bars • To thread on the joints silicone on the screws until bringing them in facings • To fix the bars presser on the bars of end using the screws M5 until reducing the play between the two to 0.8 Misters Contrôler the value with a hold thickness • To make sure that the marked pressing bars + are always side of the core n°1 and that the pressing bars – are side of the core n°12	

FIXATION DES BARREAUX COMPOSITES SUR LES BARREAUX PRESSEURS

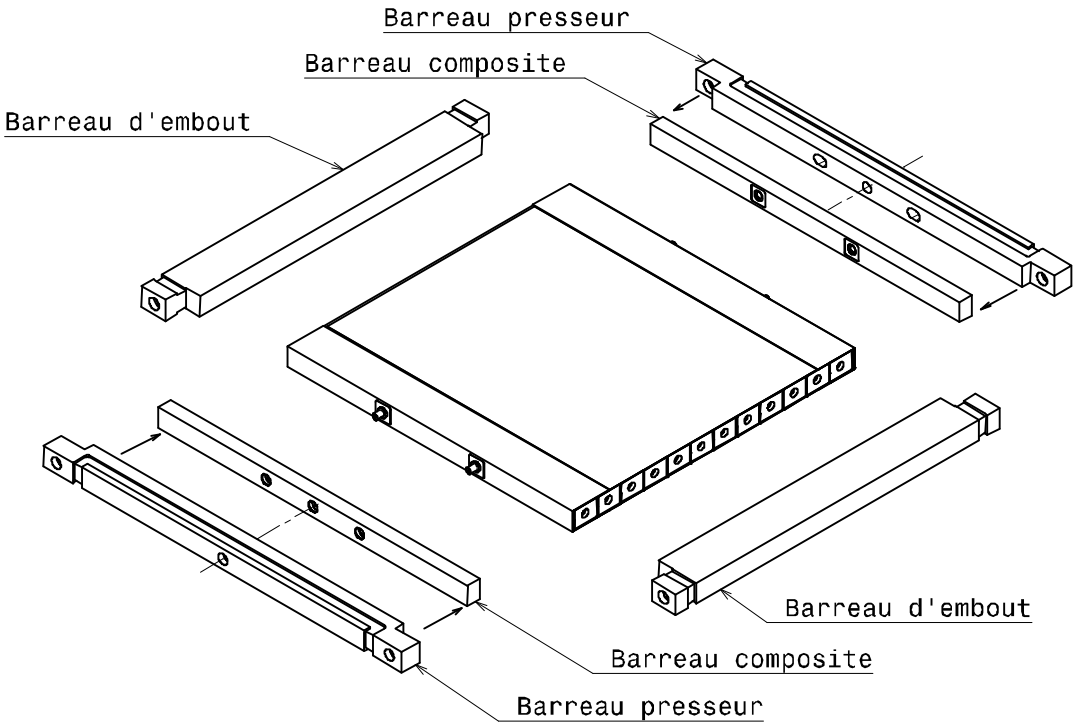


fig. 14-1

MISE EN PLACE DES BARREAUX PRESSEUR

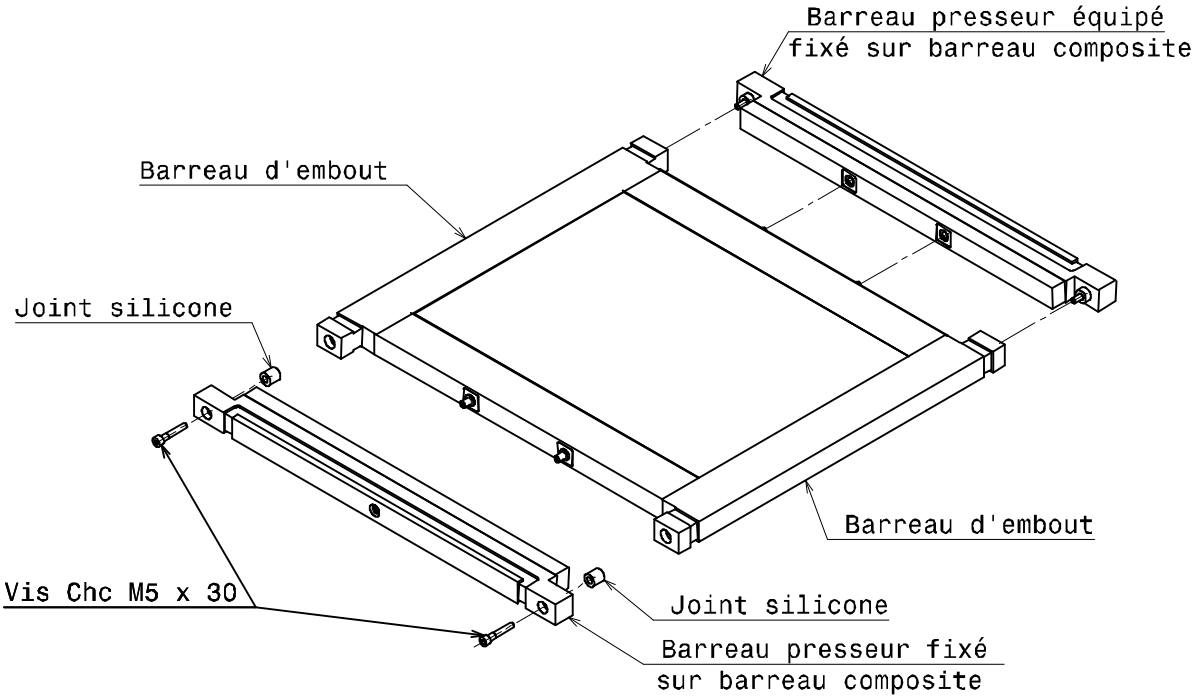


fig. 14-2

9.9 STACKING OF THE LAYERS

9.9.1 Drank

To carry out the assembly of the 8 layers and the lower and higher reinforcements in the mould

9.9.2 Elements concerned

- 7 the pre cuttings impregnated one to intercalate between the layers: PHI (interior horizontal fold)
- Parts of the tools:
  - Bed plate GLT-LLR-10-15
  - Angles GLT-LLR-10-17

9.9.3 Prepared elements

- The lower reinforcement assembled on the lower composite plate
- Successive layers 1à 8 assemblies in the order of classification

9.9.4 Tools specific

- Key for screw CHC M4

9.9.5 Operations

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	CONFIGURATION OUTILLAGE	
	• L`outillage must be assembled before the operation of stacking of the layers: the 4 angles are fixed on the bed plate at their respective positions, the pins are assembled in borings of the bed plate and the lid • The lower reinforcement is positioned	
	COUCHE 1 (figure 15)	
	• To position layer 1 on lower the reinforcement unit while being ensured than stacking pre impregnated I.E.(internal excitation) correctly comes to be placed between the overflows on the pressing bars and of end. To make sure that markings on the bed plate and the bars coïncidents • Oter the plastic film of a fold PHI and to apply it to the face superior of layer 1 while taking care of correctly centering it between the bars presser and of end. Carefully to apply the fold using a roller then to remove the paperboard of protection	

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	COUCHE 2 A 8	
	• To pile up the layers by respecting the coherence of the marking of the parts. • For each layer, to remove plastic film of a fold PHI and to apply it to the higher face of the layer while taking care of correctly centering it between the pressing bars and of end. Carefully to apply the fold using a roller then to remove the paperboard of protection	

ASSEMBLAGE DES 8 COUCHES ET DU RENFORT INFERIEUR

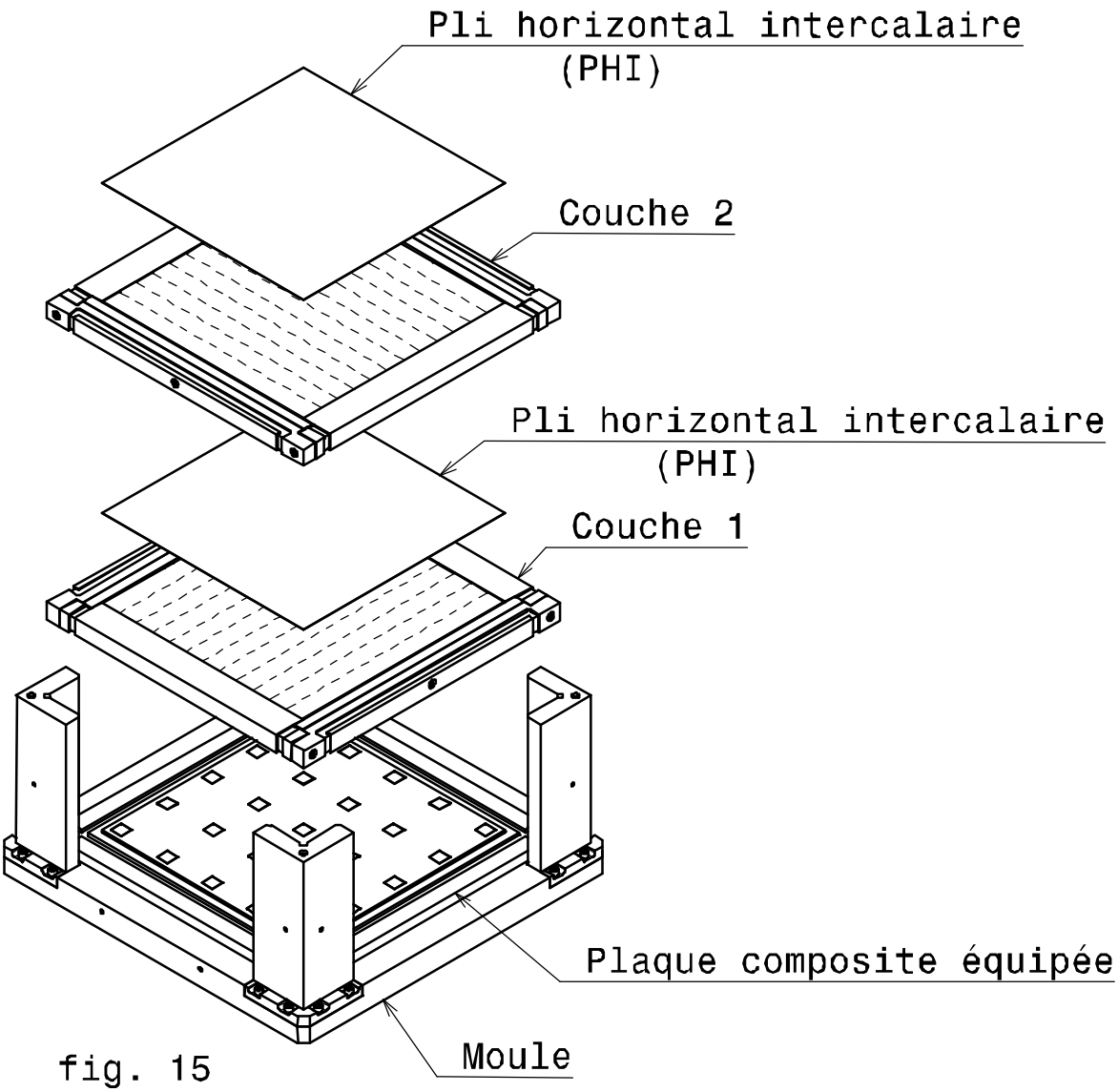


fig. 15

9.10 PREPARATION OF THE HIGHER REINFORCEMENT AND FEMETURE OF THE MOULD

9.10.1 Drank

To carry out the assembly of stackings and inserts higher on the higher composite plate of the mould

9.10.2 Elements concerned

- The pre stackings impregnated one:
  - Lower stacking 1 ES1
  - Lower stacking 2 ES2
- Parts of the tools:
  - Plate composite higher GLT-LLR-10-05
  - 16 rings Teflon of positioning of the higher inserts GLT-LLR-10-20
  - Lid GLT-LLR-10-16
  - Side plates GLT-LLR-10-18
- 16 higher inserts titanium: GLT-LLR-00-04
- The sheet aluminium of shielding GLT-LLR-00-20
- Screws 8 CHC M4x25 for the maintenance of the side plates on the angles

9.10.3 Specific tools

- Roller for compaction
- Key for screw CHC M4

9.10.4 Opérations

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MISE EN PLACE DES INSERTS (figures 16-1 et 16-2)	
	• To open the plastic sachets protecting stackings ES1 and ES2 • To supply 16 higher inserts • Oter paperboard of protection on the face 45° of stacking ES1 • To position the square base plate of the 16 inserts in cuttings of stacking • To withdraw the second sheet of protection • To check that there does not remain piece of paper of protection on the pre in particular impregnated one around the inserts • Oter paperboard of protection on the face 0° of stacking ES2 • To apply stacking ES2 to stacking ES1 while making gradually pass the cylindrical part of the 16 inserts in drillings of diameter 6mm • To bind two stackings by applying to surface a pressure to the hand or using a roller • Oter paperboard of protection on the face on which the cylindrical parts of the inserts are located • To position the whole in the mould by making sure that it is well centered and that it is adjusted correctly between the setbacks of the pressing bars and bars of end.	

PREPARATION DU RENFORT SUPERIEUR

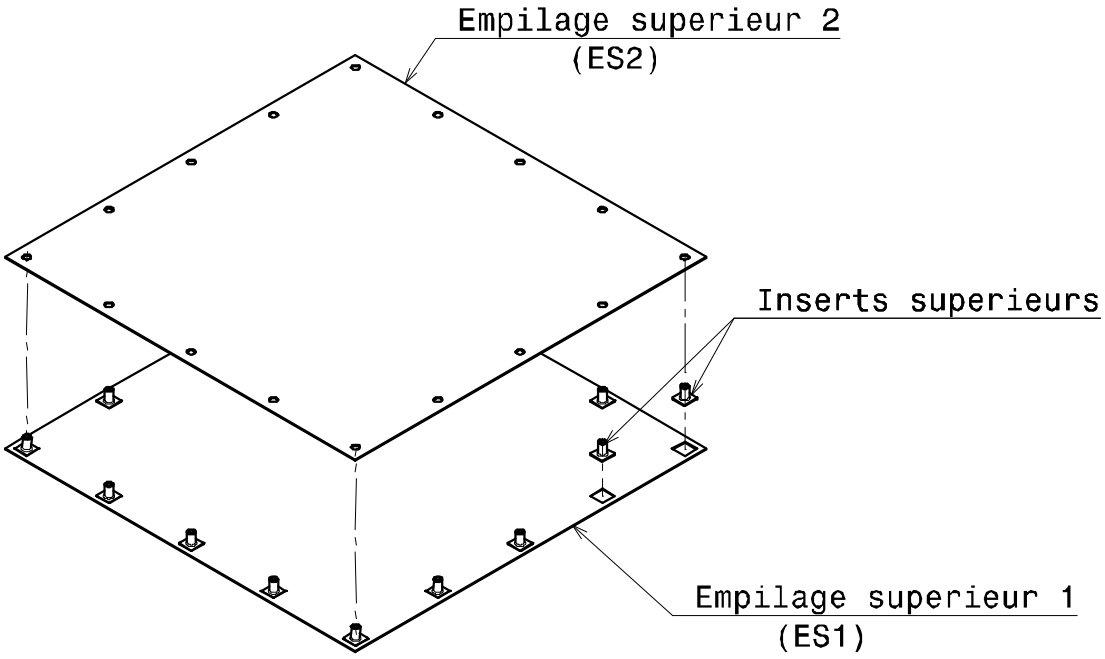


fig. 16-1

MONTAGE DANS LE MOULE

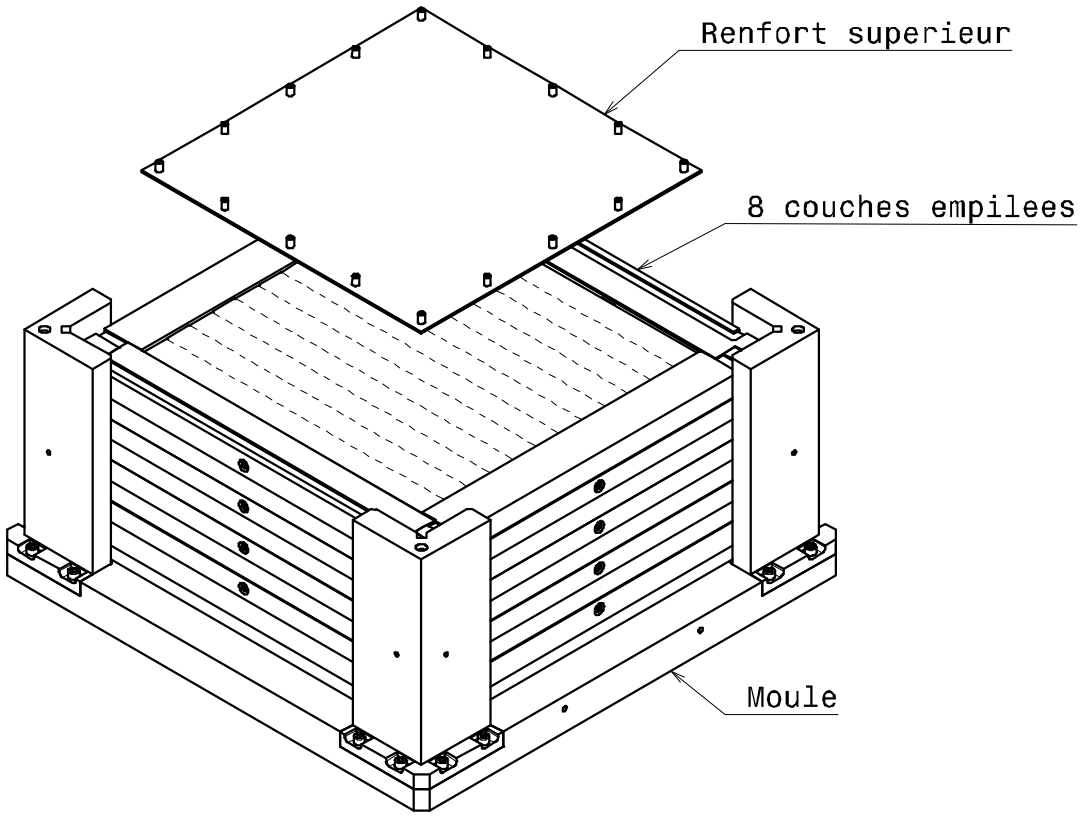


fig. 16-2

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MISE EN PLACE DE LA FEUILLE DE BLINDAGE (figure 17)	
	• To open the sachets plastic protecting the sheet from shielding • To apply the sheet of shielding to the pre impregnated one while gradually descending it around the cylindrical part of the inserts	

MISE EN PLACE DE LA FEUILLE DE BLINDAGE

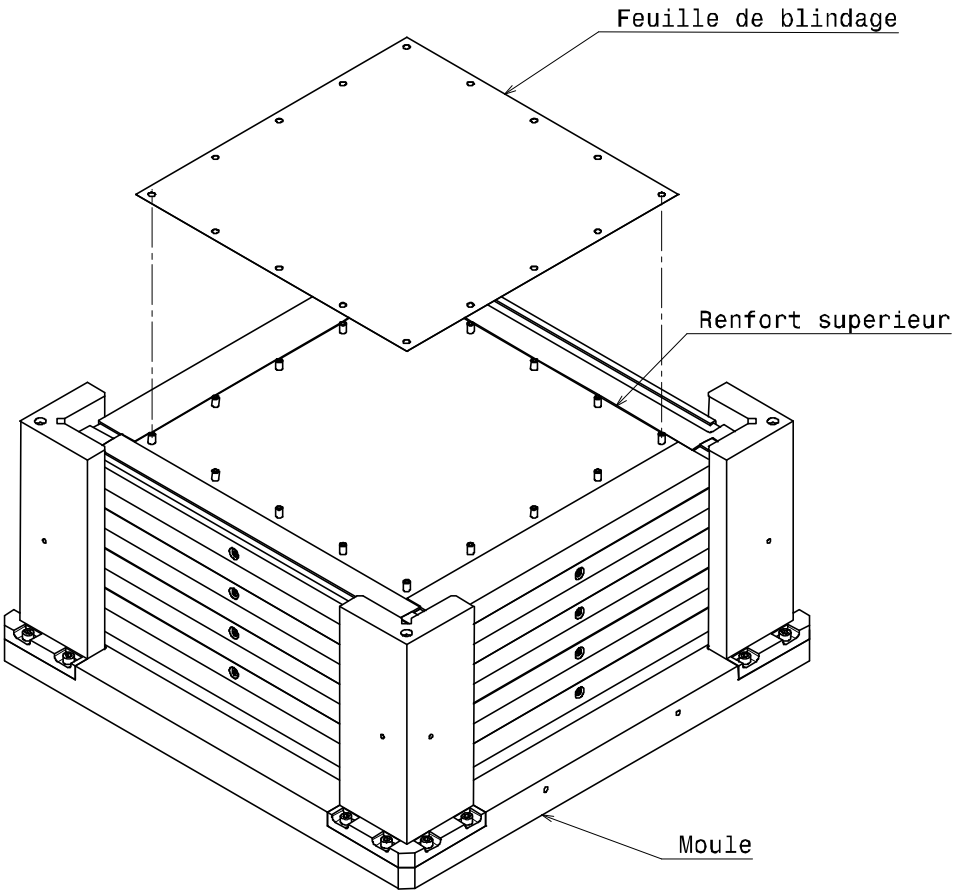


fig. 17

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	MONTAGE SUR LA PLAQUE COMPOSITE (figure 18)	
	• To open the sachets containing the rings Teflon for higher inserts • To mount a ring on the cylindrical parts of two inserts of corner diametrically opposite. The rings must be brought in contact with the sheet of shielding • To assemble the higher composite plate (with dimensions with grooves towards the interior) on the whole by using the two inserts with rings like pawns of positioning • To set up the other Téflon rings the rings must be inserted until levelling the higher face of the composite plate	

MONTAGE DE LA PLAQUE COMPOSITE

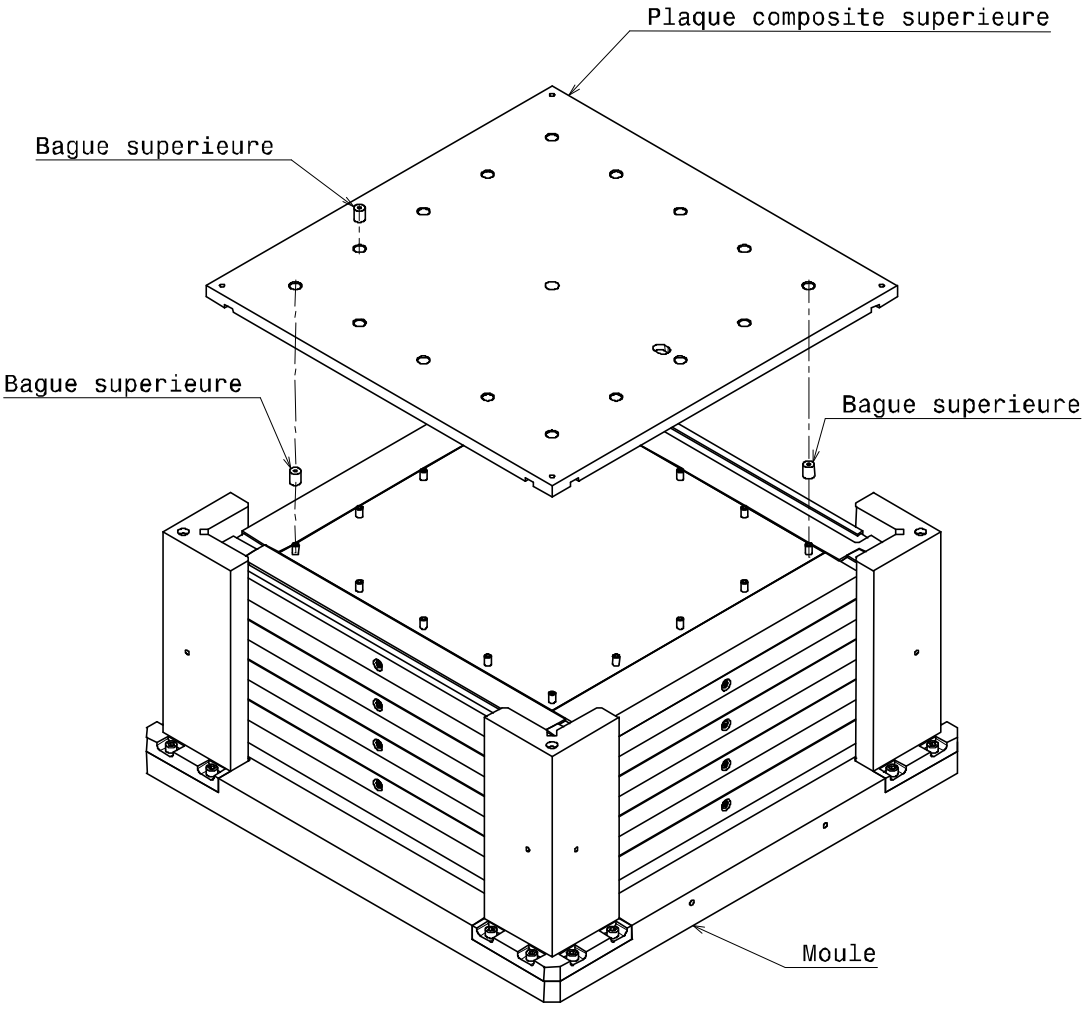


fig. 18

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	FERMETURE DU MOULE (figures 19-1 et 19-2)	
	• To position the lid on the remainder of the mould by using the pins assembled beforehand in the lid for centering. To take care that the lid engages correctly between the 4 angles. • The coherence of marking on the bars and lid must be respected • To position the side plates on each face by respecting the coherence of marking. To maintain in place using screw CHC M4x25	

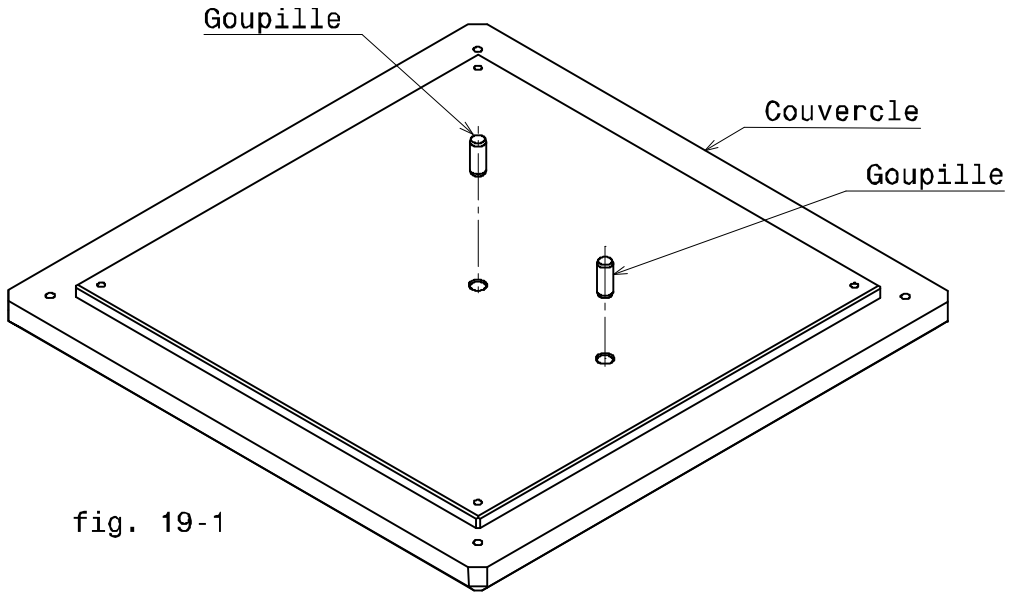


fig. 19-1

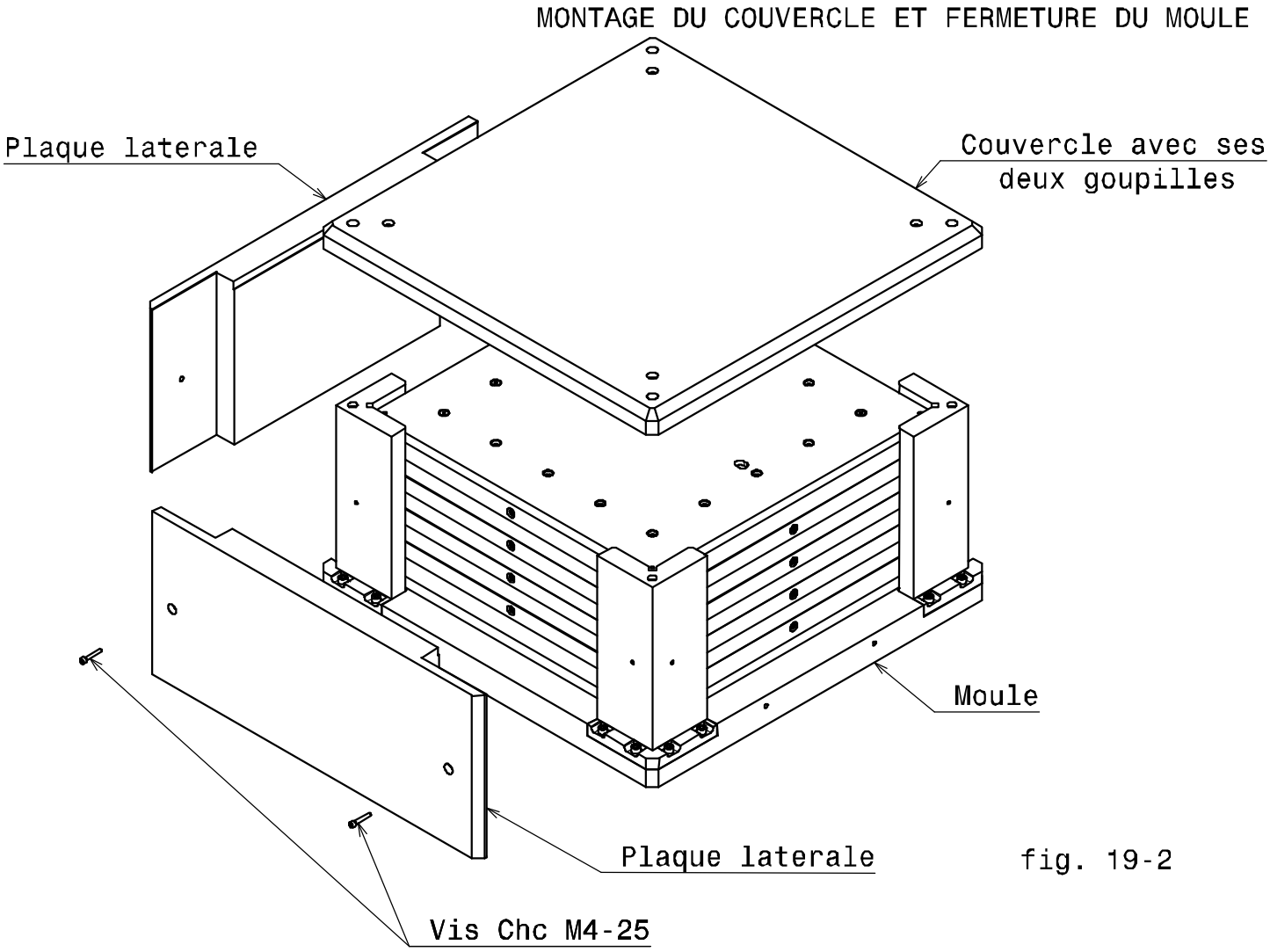


fig. 19-2

10. VACUUM SETTING AND CYCLE OF COOKING

10.1 DRANK

To carry out the vacuum setting of the tools for polymerization out of autoclave. The polymerization of the structure is carried out in the autoclave of the workshop of mechanics.

10.2 ELEMENTS CONCERNED

- The assembled mould

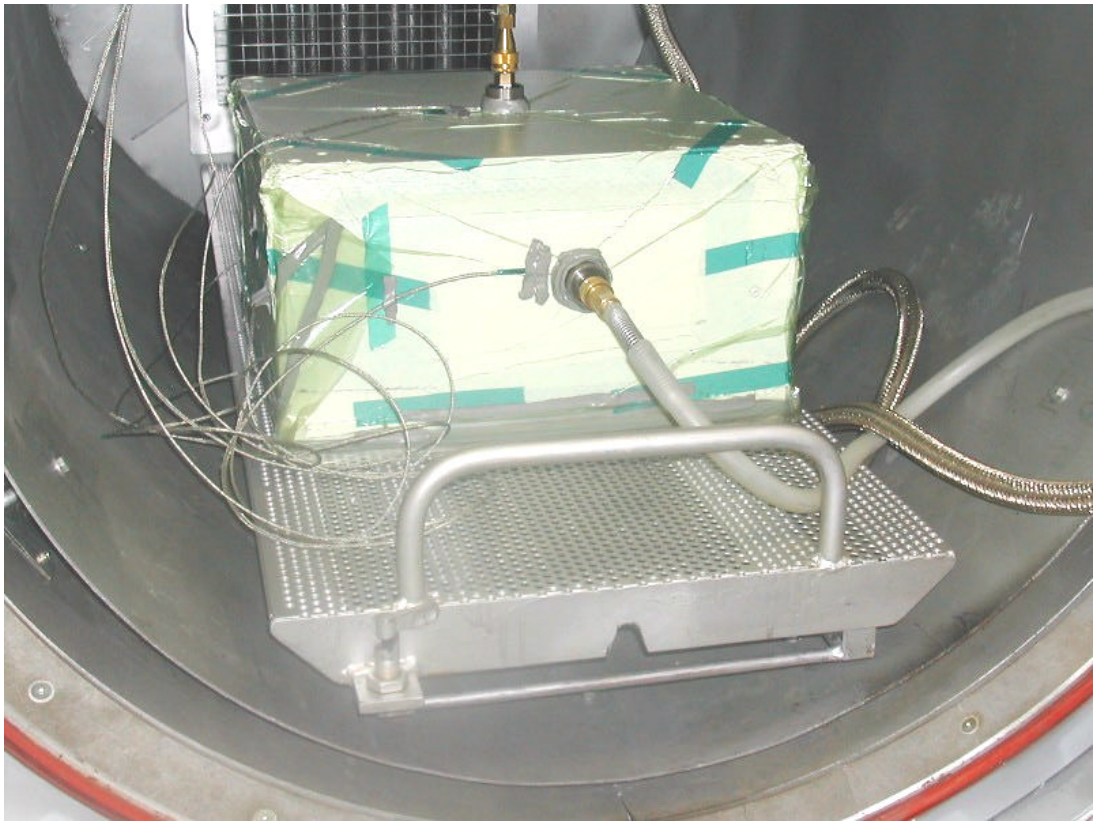
10.3 SPÉCIFICQUES TOOLS OR ELEMENTS

- Seal for the vacuum setting
- Felt drainage polyester
- Film Nylon of vacuum setting
- Adhesive tape polyester
- 2 vacuum inlets: aspiration and empty measurement
- Autoclave

10.4 OPERATIONS

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	DECOUPE MATERIEL POUR MISE AU VIDE	
	• To prepare a felt cutting of drainage to the XXxXX format, to cut out using scissors starting from the roller • To prepare a cutting of film Nylon of vacuum setting and a film cutting perforated with the XXxXX format, to cut out with the cutter starting from the roller stored in gray room	
	MISE EN PLACE FEUTRE DE DRAINAGE	
	• To cover the mould with cutting with perforated film, then the felt cutting of drainage. To fold back the corners on the side plates of the mould and to use the adhesive tape for the maintenance in place • To cut out the felt on the circumference of the bed plate on the level of the base plates of the angles and to maintain in place using the adhesive tape • To protect the edges and the holes with additional cuttings from felt to be maintained in place with the adhesive tape	
	MISE EN PLACE FILM NYLON	

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	• Fixer une bande de mastic d'étanchéité sur le pourtour de la plaque basic of the mould, below the level of the felt of drainage. To take care of applying cement well to guarantee the sealing • To cover the tools using the film Nylon. Using a point, to roughly bore it in the center of the top of the mould and the center of the side face X+. To install the couplings quick action of vacuum • To tighten the film Nylon on the 4 side faces of the mould and to apply it to the seal by avoiding any folding • To cut the points of the overflows of the film Nylon to the 4 corners of the mould, to add seal on each overflow and to finish the sealing of the unit • To put vacuum the mould and to check the good sealing of the unit	
	CUISSON EN AUTOCLAVE	
	• To equip the mould with 4 temperature gauges to position them directly on the mould • To launch the cycle of temperature, pressure and vacuum (even cycle of temperature that that advised by Composite Hexcel appendix 1)	



11. RELEASE FROM THE MOULD OF THE STRUCTURE

11.1 DRANK

This phase is carried out in the workshop of mechanics. It includes the following operations:

- Release from the mould of the structure in composite
- Fettling of the structure
- Cleaning and packing of the structure

11.2 ENVIRONMENT

Workshop of mechanics of the LLR or gray room???

11.3 PRECAUTION

The release from the mould of the structure must be done with gloves not powdered to decrease the cleaning which will take place thereafter on the parts of the mould.

11.4 SPÉCIFICQUES TOOLS OR ELEMENTS

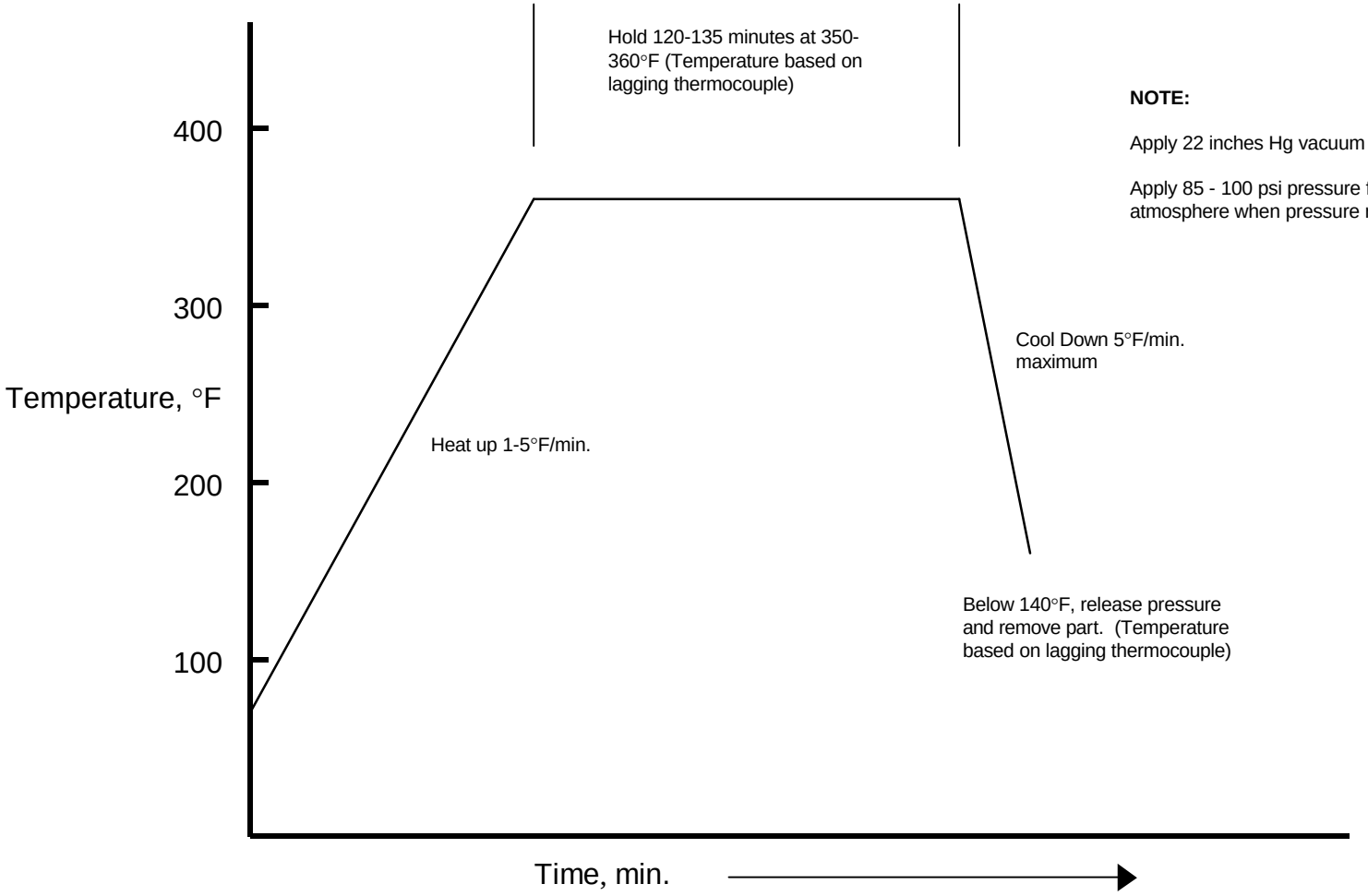
- Screwdriver for screw CHC M4
- Screw of extraction of the rings Teflons m3 for the higher rings and M4 for the lower rings

11.5 OPERATIONS

Num. Oper.	Description de l'opération	Procédure / Réf. Feuille résult. Ou commentaires
	• To withdraw plastic film, the felt and perforated film • To withdraw the lid • To unscrew the side plates, to withdraw them delicately and to arrange them in their limp respective (see labels on the boxes) • To unscrew and withdraw the angles (to arrange them in their limp: to see labels on the boxes) • To withdraw the rings Teflon (by screwing a screw in tappings of the rings, then while drawing perpendicular to the composite plate) • To extract the higher composite plate • To withdraw the fastening screws of the pressing bars on the bars of end • To withdraw the bars of end pressing bars, then the bars composite sleep by layer, to arrange the bars in their respective boxes of storage • To withdraw the cores by pushing them on a side then other to withdraw the burs, to arrange them in the boxes corresponding to their number • To disunite the lower composite plate of the bed plate of the mould • To turn over the structure • To withdraw the rings Teflon (by screwing a screw in tappings of the rings, then while drawing perpendicular to the composite plate) • To extract the lower composite plate	

Annexe 1

CURE CYCLE HSP-C1 (C5)



NOTE:

Apply 22 inches Hg vacuum minimum to vacuum bag before temperature ramp.

Apply 85 - 100 psi pressure for laminate before temperature ramp. Vent vacuum bag to atmosphere when pressure reaches 20 psig.